PSS®E 33.4

COMPATIBILITY REFERENCE AND RELEASE HISTORY

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SIEMENS

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Chapter 1

Compatibility with Previous Releases

As PSS®E continues to evolve, one of our primary concerns is to ensure backward compatibility so that current studies can be transferred to the latest program release with minimum disruption. With each new release of PSS®E, dynamic simulation users need to recompile their connection subroutines if they are still needed, and user-written models, and relink them into the new uesr model libraries.

While the vast majority of program Line Mode dialog remains unchanged, the introduction of new program features can affect this dialog. Accordingly, it is recommended that the first use in a new program release of *any* existing Response File or IPLAN program be monitored closely to ensure that it performs as intended. The version activity can be used to direct the line mode interpreter (LMI) to accept responses for earlier versions of the line mode dialog, back to version 29. Please note that API commands will nearly always be backward comapatible, in batch command or Python form.

The following sections discuss compatibility issues pertaining to the last several releases of PSS®E. These sections include summaries of the program corrections that were implemented in the corresponding major PSS®E release and any point releases. Starting with PSS®E-29, new program features are summarized. Users upgrading from a release earlier than the one immediately preceding the current release are strongly encouraged to review the notes below pertaining to all intervening program releases.

1.1 PSS®E-33

1.1.1 General

With the exception of the Power Flow Raw Data File format and the Sequence Data File format, there is complete compatibility between PSS®E-32 and PSS®E-33 at the data input file level. That is, any other source data file which could be accessed successfully by PSS®E-32 should also be able to be read directly by PSS®E-33.

Most binary files that could be read successfully by PSS®E-32 should also be able to be read directly by PSS®E-33. Most importantly, this applies to all Saved Case and Snapshot Files. There are, however, some exceptions. These are:

- Distribution Factor Data Files constructed by earlier versions of PSS®E cannot be read by PSS®E-33. They must be rebuilt by activity DFAX in PSS®E-33.

The majority of PSS®E-33 activities and functions are identical in line mode dialog to that of PSS®E-32. However, changes to the dialog of activities ARNM, ZONM, OWNM, ACCC, FLAT, INLF, LDAR, LDZO, ASCC, SEQD, SQCH and CHNG (bus data) have occurred as a result of new program features. Dialog for the new activities IMNET, NETIM, and IMOUTAGE has been added to the line mode interface.

1.2 New Features

The following new features are added at PSS®E-33.0:

- A native induction machine model has been added.
- Normal and emergency voltage limits are associated with each bus. They are accessible from the BUSDAT single element fetch routine and from the aBusReal subsystem data retrievel API routine. They may also be used to seed the OPF bus voltage limit values, either individually or on a subsystem basis. Additional uses of these limits will be implemented in a future PSS®E release.
- Each load may be characterized as either interruptible or non-interruptible. This attribute will be utilized in a future PSS®E release.
- An alphanumeric vector group may be associated with each two- and three-winding transformer.
- For each of the power flow data entry and data changing API routines (e.g., BRANCH_DATA), a new data changing API routine (e.g., BRANCH_CHNG) is supplied. The _CHNG API routines can only modify data for an element that already exists in the case. Specifically, they cannot add a new element to the case.
- There is a factor of 10 increase in the maximum number of zero impedance lines allowed at all size levels. For example, at 50,000 buses, the maximum number of zero impedance lines is increased from 2,500 to 25,000.
- There is a modest increase in the maximum number of two-terminal dc lines allowed at size levels of 4,000 buses and above. At 50,000 buses and above, the maximum number of two-terminal dc lines is increased from 50 to 100.
- A new solution parameter, MXTPSS, may be used to overcome the oscillations that can occur in the automatic adjustments of tap ratio and switched shunt settings during power flow solutions. Once tap and/or switched shunts have been adjusted MXTPSS times during a solution, further adjustments are suppressed.
- Several enhancements in the Contingency Description Data File have been implemented:
- The ADD and REMOVE commands allow the status change of an individual induction machine.
- The Monitored Element Data File, has been modified as follows:
- The Sequence Data File format has been redesigned to allow greater flexibility as well as a more convenient transfer of sequence data from its engineering sources into PSS®E.
- The fault analysis positive sequence machine data includes provision for specifying subtransient, transient, and synchronous reactances. The various fault analysis calculation activities, as well as the generator conversion activity CONG, allow selection of the reactance to be used.
- Additional modeling options are available in activity FLAT.

- The maximum number of dynamic simulation user-written model definitions has been increased to 500 at all size levels.
- The bus voltage recovery and voltage dip violations checks during dynamic simulation fault recovery can now be performed on a bus subsystem basis.
- Option to perform generator angle scan for machines above a specified MVA size.
- A new feature that allows support for COMTRADE files. The PSS®E plot package can now read the COMTRADE format files and plot the data values using the plotting tool in PSS®E.
- At PSS®E-33, provision has been made to call every PSS®E dynamic model from within PSS®E without the need for an explicit call statement in the connection routines (CONEC and CONET). As a consequence of this change, none of the PSS®E supplied library of models would require any compilation or linking of the connection routines. New family of models (called CCT model type) has been introduced to replace the old CONEC and CONET type models. By using the new CCT model type (in place of the old CONEC-CONET type models) users will be able to preclude user models from being called in the CONEC and CONET subroutines and thereby avoid compilation and linking of these routines.
- A new model type called the induction machine model has been added to allow dynamic models to be created for those machines that are designated as induction machines in PSS®E power flow. Although in version 33.0 there are no PSS®E standard induction machine models that can be attached to the induction machines in power flow, PSS®E users can write user-written induction machine models that keys off the induction machines in power flow.

1.3 Power Flow Raw Data File

The following are the changes to the Power Flow Raw Data File format:

- Four additional data items, NVHI, NVLO, EVHI and EVLO, are specified at the end of the bus data record. NVHI and NVLO are the normal voltage limits, and EVHI and EVLO are the emergency voltage limits.
- An additional data item, INTRPT, is specified at the end of the load data record. INTRPT is a flag indicating if the load is interruptible.
- An additional data item, VECGRP, is specified at the end of the first record of the transformer data block. The alphanumeric vector group indicates the transformer's winding connections and phase shift angles.
- A new data category, induction machine data, is added to the end of the file, following the GNE device data.

1.4 Sequence Data File

The following are the changes for the Sequence Data File format:

- On the first data record, the integer REV follows the change code value, IC. REV indicates the major revision number, thus defining the format of the data records in the file.
- The generator positive, negative, and zero sequence impedance data categories have been replaced with a single generator sequence data category.

- The exceptional negative and zero sequence shunt load data categories have been replaced with a single load sequence data category.
- The format of, and the data specified on, the zero sequence transformer data record has been completely redesigned.
- On the zero sequence switched shunt data records and the zero sequence fixed shunt data records, zero sequence admittances are specified in Mvar at unity voltage rather than in per unit.
- A new data category, induction machine sequence data, is added to the end of the file, following the zero sequence fixed shunt data.

1.5 Dynamic Simulation Model Library

The following models are added to the PSS®E simulation model library:

- ABBSVC1 – ABB SVC model
- WT4G2 – Generic wind turbine model representing a generator connected to the grid via a power converter (Type – 4 wind machine)
- WT4E2 – Generic electrical control model for Type 4 wind machine
- VFT1 – GE variable frequency transformer

All the models can be used in the standard state-space simulations only.

The following models have been converted from the old CONEC-CONET form into a new table-driven form (i.e., where the model calls are not generated in CONEC and CONET subroutines).

Old Model Name	New Model Name
DCTC1	DCTC1T
LOEXR1	LOEXR1T
VTGDCA	VTGDCAT
VTGTPA	VTGTPAT
FRQDCA	FRQDCAT
FRQTPA	FRQTPAT
SWCAP	SWCAPT
SAT2	SAT2T
OLTC1	OLTC1T
OLPS1	OLPS1T
OLTC3	OLTC3T
OLPS3	OLPS3T
CRANI	CRANIT
RUNBK	RUNBKT
CHIGAT	CHIGATT
CEELRI	CEELRIT
CMDWAS	CMDWAST
CMDWS2	CMDWS2T
CMFORD	CMFORDT

1.6 Program Corrections

The following program errors have been detected and corrected in PSS®E-33.0:

- In P-V analysis, if a wind machine whose reactive power limits are a function of the machine's active power and a specified power factor participates in the transfer, its reactive power limits were not updated when its active power output was changed.

In changing multi-terminal dc line data, if an invalid second dc bus is specified for a converter (e.g., dc bus 8 is specified when there are only 6 buses in the multi-terminal dc line), the converter bus could be identified incorrectly in the error message.

1.7 Optimal Power Flow

- Optimal power flow data APIs will use default values for values not entered, and any data changes and modifications are now reported in the **Progress** area.
- New optimal power flow APIs, OPF_LNCEQN_BRFLOW, OPF_LNCEQN_INTFLOW, OPF_LNCEQN_ADJVAR, OPF_LNCEQN_SWSHUNT, and OPF_LNCEQN_ADJLOAD are introduced to coincide with PURGE_OPF_LNCEQN_ commands of the same name. The original APIs still work and simply call the new ones.
- New optimal power flow APIs OPF_INTERIOR_SHIFT_FACTOR and SET_OPF_REPORT_SUBSYSTEM are introduced for recording purposes.

For the complete set of changes to the optimal power flow APIs, refer to Chapter 3 of the API manual.

1.8 PSS®E-32

1.8.1 General

With the exception of the Power Flow Raw Data File format, there is complete compatibility between PSS®E-31 and PSS®E-32 at the data input file level. That is, any other binary or source data file which could be successfully accessed by PSS®E-31 should also be able to be read by PSS®E-32.

1.8.2 New Features

The following new features are added at PSS®E-32.0:

- The three permanent working files are eliminated. In their place, several temporary scratch files are created and used as needed. This avoids the potential collision of the working files when multiple copies of PSS®E are executing at the same time. This also reduces the number of occurrences of functions being allowed to execute when their pre-requisite data is not current in the working files.
- When reading a Saved Case File or a Snapshot File which exceeds PSS®E's dimensional capacities, PSS®E automatically re-dimensions itself to a size level that is able to accommodate the Saved Case or Snapshot.
- There is a modest increase in the maximum number of zero impedance lines allowed at all size levels greater than 4,000 buses.
- Each load may be characterized as either scalable (conforming) or fixed (non-conforming). Only scalable subsystem loads are modified by the SCAL API routine; similarly, only scalable subsystem loads participate in the transfer increment of P-V analysis when subsystem load is specified as the transfer increment method.
- A status attribute is associated with each switched shunt.

- Each switched shunt operating in discrete mode may be adjusted using either of two adjustment methods:
    - the sequential input order method in use prior to revision 32;
    - a nearest combination method in which an arbitrary combination of switched shunt blocks may be switched on so as to obtain the next higher (or lower, as appropriate) total switched shunt admittance; in this method, both reactors and capacitors may be switched on at the same time.
- The first character of the circuit identifier of non-transformer branches may be used to characterize a branch as a breaker or a switch. If the first character is an at sign (@), the branch is treated as a breaker; if it is an asterisk (*), it is treated as a switch. Typically, breakers and switches are zero impedance lines; however, any non-transformer branch may be treated as a breaker or a switch.
- The restriction which prohibits zero impedance line connected loops is removed.
- While limits still exist on the total number of each of areas, owners and zones that may be represented, area, owner and zone numbers between 1 and 9999 may be used at all size levels of PSS®E.
- An option has been added to activity RAWD indicating which loads are to be included in its output:
    - all loads at subsystem buses.
    - subsystem loads at all buses.
    - all loads at subsystem buses and subsystem loads at non-subsystem buses.
- The report of activity AREA has been expanded to tabulate three categories of load: area load at area buses; area load at non-area buses; and non-area load at area buses. Two categories of net interchange are tabulated: tie flows; and tie flows plus loads. Similar changes are implemented in activity ZONE. The reports of area totals with zone subtotals and of zone totals with area subtotals are unchanged.
- A function is added which produces a report of the amount of load reduction in a specified subsystem resulting from the voltage at load buses falling below PQBRAK (for constant MVA loads) and 0.5 (for constant current loads).
- There is added flexibility in the branch overload checking function which is accessible from the *Branches* tab of the dialog brought up by the ***Power Flow>Reports>Limit checking reports...*** menu entry.
- Several enhancements in the Contingency Description Data File have been implemented:
    - A command to generate a series of single machine outage contingency cases is added.
    - A command to disconnect in turn all in-service buses in a specified subsystem is added.
    - The automatic single and double line outage contingency commands SINGLE, DOUBLE, BUSDOUBLE and PARALLEL have been modified as follows:

        If the keyword BRANCH, LINE or TIE is specified, all branches in the grouping except breakers and switches are included in the contingencies.

If the keyword BREAKER is specified, only breakers and switches in the grouping are included in the contingencies.

- A command to trip an in-service switched shunt may be specified as a contingency event.
- The ADD and REMOVE commands allow the status change of an individual load or fixed shunt.
- The ALTER/SET/INCREASE/DECREASE ... SHUNT commands recognize the MVAR keyword in addition to MW and PERCENT.
- A command to change current or power demand, and scheduled compounded dc voltage of two-terminal dc lines is added.

• In the Monitored Element Data File, the commands for monitoring branches have been modified as follows:
  - If the keyword BRANCH, LINE or TIE is specified, all branches in the grouping except breakers and switches are added as monitored elements.
  - If the keyword BREAKER is specified, only breakers and switches in the grouping are added as monitored elements.
• Activity RNFI (Renumber Buses in Auxiliary Files) is able to renumber Subsystem Description Data Files, Monitored Element Data Files, Contingency Description Data Files, and Tripping Element Data Files.
• The P-V analysis calculation has been extended to allow a negative minimum incremental transfer.
• The zero sequence two-winding transformer connection code 9 provides for a series impedance connected to the winding 1 bus, a series impedance connected to the winding 2 bus, and an impedance to ground at the junction point of the two series impedances.
• PSAS commands have been added which correspond to the calculations accessible from the ***Disturbance>Calculate and apply unbalanced bus fault...*** and ***Disturbance>Calculate and apply branch unbalance...*** menu entries (i.e., to the DIST_SCMU_FAULT and DIST_SPCB_FAULT API routines).
• The DISCONNECT BUS command of PSAS and PSEB permits an optional [n] field (i.e., descriptive text) at the end of the record.
• An API routine is added to each family of the subsystem data retrieval API routines. It returns information on the data types corresponding to specified STRING values, each of which may be specified to one or more of the data retrieval API routines in the family.
• Substation Reliability Assessment (SRA) has been provided to evaluate reliability of a substation in terms of frequency and probability of substation related outages that lead to violation of the substation performance criteria.
• Three types of controls, off-line generator control, tap setting adjustment and switched shunt control, have been added into AC corrective action function.
• The number of contingency elements in a contingency event is increased from 16 to 32.
• In Multiple AC contingency run report, the monitored element's rating is taken from the appropriate rating set as obtained from the Contingency Solution Output File which it is present, instead of the Contingency Solution Output File being first encountered in the previous versions.

- The model edit dialogs (which are used to edit model CONs and ICONs) can now be used to edit the model VARs as well.
- New monitoring models that check for bus voltage recovery and voltage dip violations during dynamic simulation fault recovery have been added as part of Dynamic Simulation Options.
- GUI access to change or increment governor reference has been added.
- Dynamic simulation model names can be up to 16 characters long.
- The maximum number of dynamic simulation user-written model definitions has been increased to 200 at all size levels.
- The list of loaded libraries that had been included in the display under Help>About has been removed. It has been replaced with a revised display available under Help>Loaded Libraries
- A new application, pssecmd, is included with PSS®E-32. It is a console application version of the command line in the PSS®E GUI.

1.8.3 Power Flow Raw Data File

The following are the changes to the Power Flow Raw Data File format:

- An additional data item, SCALE, is specified at the end of the Load Data record. Each load is characterized as either a scalable load or a fixed load.
- Two additional data items, ADJM and STAT, are specified between the MODSW and VSWHI data items on the Switched Shunt Data record. ADJM defines the adjustment method to be used by the automatic switched shunt adjustment of the power flow solutions. STAT defines the switched shunt status.

1.8.4 Line Mode

- The full HELP activity is now implemented.
- IDEV, EXEC, and immediate (@) commands can now be used interactively.
- PSAS and PSEB are no longer limited to CHECK mode interactively.
- Activity RAWD will have an additional prompt for the new option for including loads.
- The VERSION command, when used in a Response file, will return to the previous value when the Response file terminates.

1.8.5 Dynamic Simulation Model Library

The following models are added to the PSS®E simulation model library:

ST5B, ST7B, DC3A - New excitation system models proposed in the IEEE 421.5-2005 standard

PSS4B - New power system stabilizer models proposed in the IEEE 421.5- 2005 standard

CDC7T – Generic two-terminal dc line model with hvdc cable and/or overhead line

UEL1 - New under-excitation limiter model proposed in the IEEE 421.5-2005 standard

WT1G1 - Generic wind turbine model representing the direct connected induction generator (Type-1 wind machine)

WT2G1 - Generic wind turbine model representing the wound rotor induction generator with variable resistance control (Type-2 wind machine)

WT3G2 – Generic wind turbine model representing the doubly-fed induction generator (Type-3 wind machine)

WT4G1 - Generic wind turbine model representing a generator connected to the grid via a power converter (Type – 4 wind machine)

WT12A1 – Generic aerodynamic model for Types 1 and 2 wind machine

WT2E1 - Generic electrical control model for the Type-2 wind machine

WT4E1 - Generic electrical control model for the Type-3 wind machine

WT12T1 - Generic mechanical system model for the Types 1 and 2 wind machine

All the models can be used in the standard state-space simulations only.

1.8.6 Optimal Power Flow

- Optimal power flow data APIs will use default values for values not entered, and any data changes and modifications are now reported in the **Progress** area.
- New optimal power flow APIs, OPF_LNCEQN_BRFLOW, OPF_LNCEQN_INTFLOW, OPF_LNCEQN_ADJVAR, OPF_LNCEQN_SWSHUNT, and OPF_LNCEQN_ADJLOAD are introduced to coincide with PURGE_OPF_LNCEQN_ commands of the same name. The original APIs still work and simply call the new ones.
- New optimal power flow APIs OPF_INTERIOR_SHIFT_FACTOR and SET_OPF_REPORT_SUBSYSTEM are introduced for recording purposes.

For the complete set of changes to the optimal power flow APIs, refer to Chapter 3 of the API manual.

1.8.7 Program Corrections

The following program errors have been detected and corrected in PSS®E-32.0:

- TLTG, SPIL, and POLY could have crashed or included multi-section lines in the report multiple times if both of the following were satisfied:
  - the multi-section line reporting program option setting was enabled; and
  - one or more study system ties were multi-section lines.

The following program errors have been detected and corrected in PSS®E-32.0.1:

- Fixed an issue with Data Record dialogs displaying short circuit data.
- Controls are updated correctly when opening the DOCU dialog.
- Fixed an issue with the Area, Owner and Zone spreadsheet when adding new elements.
- Resize the row height if the font is changed.
- Fixed a problem with a floating output bar and toggling the Diagram through the toolbar.
- Use quote, not apostrophe, to quote filenames for automation files.
- Spreadsheets are reset after reading SEQ data.
- Fixed an issue with adding a Bus Load model.
- The area, owner, and zone subsystem data retrieval routines for real and complex data would sometimes return incorrect results.
- Preserve the original area interchange option setting in PV solution.
- Fixed several issues with embedded and standalone raw file converters and creators.
- Fixed several issues in Python extension modules, psspy, casepy and excelpy.
- In transformer data input and data changing, update RMA and RMI when CW=3 and the control mode is 1 or 2.
- Following the use of GDIF to plot differences on a slider diagram, subsequent executions of GDIF or DIFF would crash.
- In TIES and TIEZ, fixed a formatting error in reporting load ties.
- Fixed an issue in ECDI when looking for the least expensive unit to place in-service.
- Fixed several issues in USRCAS that were reflected in the raw file converters e.g. Taps were set to 0.
- Several fixes in output and stability of embedded UCTE converters.
- Fixed a line mode issue when running SCMU and selecting no output.
- Indeplot output windows now allow Copy selection from the context menu.

The following program errors have been detected and corrected in PSS®E-32.0.2:

- Fixed issues with closing log files for RAW file converter and creator utilities.
- Minor fixes in dynamic models CEELT, MNLEX3, and SWSHN1.
- Fixed some issues in PSS®E functions that invoke dynamic models of switched shunts.
- Fixed Ik current contribution and post fault voltage calculations in IECS.
- Corrected errors in Saved Case Data Extraction Routines (Usrcas) when reading some older saved cases.

- In the area and zone tie line summary reports (TIES and TIEZ), tie branches could be omitted.
- Power flow solutions could have crashed when all of the following conditions were satisfied:
    - the switched shunt adjustment option was Enable all
    - a switched shunt was controlling the Mvar output of a plant
    - the type code of the bus to which the plant is connected was 2
    - all machines at the controlled plant were out-of-service
- Incorrect messages could get printed when adding a switched shunt or changing switched shunt data and a remote bus number of a bus not in the case was specified.
- Fixed an issue with changing Ids on three winding transformers.
- Fixed several issues with star point buses.
- Several changes to OPF data changing APIs.
- Line Mode Interpreter (LMI) improvements and corrections:
    - Corrected CHNG, changing load scale flag
    - Corrected CHNG, setting blocks for switched shunts
    - Prompts now handled by Prompt virtual device
    - Added missing VREF prompt for ESTR
    - Corrected checks for areas and zones in use
    - Set defaults for ASCC output and SCMU 2-phase faults
    - Handle multiple machines per plant in DYCH opts 3 & 4
    - Correct terminal input to RETI
    - Corrected call to DLST API routine
    - Correct mismatch check handling (DCCC, DCLF, MWMI, RANK, SPIL, TLTG)
    - Add version 31 states for PURG and DYCH
    - Correct message for missing FACTS device
    - Set defaults for CHNG 2-term dc data (only set changed data)
    - Correct displays of bus code, transformer bus names, and switched shunt data in CHNG
    - Correct displays of dc line data in CHNG for multi-terminal dc lines
    - Correct displays of 8 character (rev 29) bus names
- Fixed an issue with recording the addition of dc line models.
- A double stepwise tap adjustment could occur during the same power flow iteration, causing oscillating convergence characteristics. This can happen under the following conditions:

- Either stepping tap adjustment is enabled, or direct tap adjustment is enabled but the direct adjustment fails and the stepping method is then enabled.
- Reactive power flow controlling transformers are active.
- In solving the reactive power flow controlling transformers, the direct method fails.
- Challenging voltage control objectives (e.g., a narrow voltage range relative to the tap step) are specified for voltage controlling transformers.

- Fixed an issue with saving CONS in FACTS models.
- Fixed an issue when adding Dynamics data without an existing Dynamics data
- Fixed an issue with recording values in the voltage monitoring model.
- Fixed an issue with recording values in ACCC_TRIP_COR_2.
- Fixed an issue with mis-identified buses in ACCC runs.
- Fixed an issue with exporting QV results.
- Fixed an issue with deleting all the Plots in a Plot Book.
- Fixed an issue with closing an empty Plot Book.
- Fixed an issue with parsing Decimal values in dialogs when the locale is set to use a character other than a . as the decimal point symbol.
- Fixed an issue when opening a Scenario and selecting the header.
- Fixed an issue creating Area, Owner and Zone lists in subsystem selectors.
- Fixed an issue with transformer, bus, dc line and switched shunt results on diagrams.
- Fixed a crash that occurred when GDIF results were refreshed on a diagram.
- Fixed an issue with changing OPF Generation Dispatch data by subsystem.
- Fixed several issues with wrong APIs being called when changing OPF parameters.
- Fixed several issues with OPF dialogs.
- Fixed an issue with Controlled bus numbers when copying three winding transformers.
- Added missing connection code in two winding transformer spreadsheet.
- Fixed issues with adding Areas, Owners and Zones without numbers.
- Rectifier and inverter were not added correctly when adding a new dc line through the spreadsheet.
- Fixed an issue with the ordering of elements on the plant and switched shunt data spreadsheets.
- Fixed an issue with displaying Area numbers on the inter-area transfer spreadsheet.
- Fixed an issue with running short circuit reports using the SCOP dialog.
- Fixed issues in the dc line and vsc dc line dynamic spreadsheets.

- Fixed issues with the Dynamics Network Options dialog.
- Fixed and/or improved several issues with Event Studies:
  - Event study properties are now honored in RUN.
  - Any automation files at start of Event Study are run before STRT is executed.
  - Prompt to save open Event file upon closing PSS®E rather than doing so automatically.
  - When running event study, suppress recording of Event APIs and only capture the RunStudy call.
  - Enable/disable the Close Event Study file menu item based on whether a file has been opened or not.
- Fixed issue with range of PU step in GSTR/GRUN dialog.
- Fixed several issues with the command line input bar.
- Fixed several issues with corrective action weighting factors in Multi-level ACCC analysis.
- Fixed several issues with the Program Settings/OPTN dialog.
- Fixed several issues with setting short circuit results on diagrams.
- Fixed an issue when overwriting Diagram Template files.
- Fixed several issues with data record dialogs not displaying the correct units.
- Fixed several issues with data record dialogs changing connection codes for transformers.
- Fixed several issues with data record dialogs not updating changes in spreadsheets.
- Fixed an issue with exporting Plot data to Excel.
- Fixed Load - All label on Dynamics Tree View.
- Fixed label positions on diagrams for dc line items.
- Fixed an issue with pasting Report Nodes on diagrams.
- Fixed an issue with data record dialogs and non-existent items.
- Fixed an issue where the annotation text dialog would continue to re-appear after adding a diagram template to the diagram.
- Fixed an issue of multiple 3 winding transformers being added when growing a bus.
- Fixed an issue with the wrong suffix being used when running a Python automation file.
- Fixed an issue with the default bus height and spacing getting clobbered.
- Fixed an issue with memorizing bus subsystems.
- Entering buses through the Following buses field in was limited to 100 buses.

The following program errors have been detected and corrected in PSS®E-32.0.3:

- Fixed issues with aBrnReal() and similar APIs so that flows of 0.0 are returned for out-of-service branches.
- Fixed minor issue in comparing mutual B factors.
- Fixed minor issues in the following models, swshn1,vtgdca and vscdct.
- Fixed an issue with IEC fault calculation and the use of Impedance Correction factors.
- Fixed an issue with Response and IPLAN automation files launched from Custom Toolbar buttons.
- Fixed an issue with corruption of the Custom Toolbar definition file.
- Fixed an issue with updating Diagram results for three winding transformers if one or more of the windings were not drawn.
- Fixed an issue with Grow operations zooming out to the extents of the Diagram and not the extents of the items just added.
- Fixed a program crash when the last report was deleted and another report was created.
- Fixed an issue with updating Transformer tap arrows when changed in a Property sheet dialog.
- Fixed an issue with updating the VSC name in the Switched Shunt Property sheet dialog.
- Fixed an issue with three winding transformers not being added to an Event Study.
- Fixed an issue with the By kV setting not being retained on the Bus Subsystem Selector dialog.
- Fixed an issue with the display of Owner numbers in the Owner spreadsheet.
- Fixed an issue with displaying flow arrows for short circuit results on Diagrams.
- Fixed a program crash with Diagrams that contained missing kneepoints.
- Fixed an issue in READ where it could skip a two-terminal dc line for which a non-fatal data error on the first data record was detected.
- Fixed an issue in RAWD where, for a wind machine with four owners, part of the fourth ownership fraction was overwritten with the wind machine data.
- Fixed a program crash in contingency analysis under the following conditions:
    - Generation dispatch mode is set to 4.
    - The Pmax and Pmin of a participating machine specified in the Inertia and Governor Response Data File are equal.

The following program errors have been detected and corrected in PSS®E-32.0.4:

- When tapping a line (activity LTAP), incorrect owner numbers could be assigned to one of the two branches that replace the original line.
- If a contingency event changes the active power output of a wind machine having a reactive power control mode of 2 or 3, the reactive power limits of the machine are updated.

- Fixed possible error during automatic resizing when both power flow and dynamics data are present in memory.
- In activity READ, the printing of certain switched warning messages was suppressed.
- Fixed possible error during power flow solutions in checking for in-service ac branches parallel to a series FACTS device.
- Fixed possible error in converting loads by subsystem.
- Fixed potential error when operating on a subsystem with a multi-entry API routine from the GUI (e.g., CONL).
- In activity JOIN, if one of the buses specified was a type 4 bus, the wrong bus could be reported.
- In activity JOIN, if a transformer between the two buses was controlling a two-terminal dc line quantity, the dc line name was not reported.
- In several topology modification activities such as EXTR and PURG, if the ac measuring bus of a two-terminal dc line or a transformer that was controlling a two-terminal dc line quantity was removed, the dc line name was not reported.
- Fixed potential error that could occur in short circuit with an invalid topological specification (a mutual coupling involving an in-service branch that is connected to a type 4 bus).
- Fixed issue in IEC Symmetrical Breaking current calculations by IECS_2 API.
- Fixed an issue with DYRE,ADD of wind models.
- For dynamics model AC8B, in the event of VR hitting limit, STATE(K+3) was not being set equal to the limit.
- For dynamics model CDSMS1, fixed an issue when all the model CONs are zero, and MODE is > 4.
- The following API routines were not recognized in batch commands: EXPORTIMAGEFILE, IMPORTIMAGEFILE, ENABLEDIAGCONTOUR, CHANGEDIAGCONTOUR, REFRESHDIAGFILE, REFRESHDIAGCONTOUR, DELETEDIAGCONTOUR.
- Corrected sequence of prompts in Line Mode CHNG for machines when Version set to 30.
- Fixed issue in pssarrays.ascc_currents and pssarrays.iecs_currents in maximum fault current calculation. Updated PV and QV functions to return convergence condition.
- Data sheets could sometimes record changes when no changes actually took place.
- Corrected extra line feeds in Python output to Progress.
- Fixed an issue that could prevent AUTO_OPEN and AUTO_CLOSE files from being added to the scenario though the scenario editor.
- Adding channels via the channel wizard could result in an error if the next channel being added was greater than the maximum allowed channels.
- Fixed an issue with Copy/Paste from a Slider diagram to another application.

The following program errors have been detected and corrected in PSS®E-32.0.5:

- Updated sample.raw.
- In processing the Contingency Description Data File, the BLOCK MULTITERMDC contingency event could cause a program crash.
- Fixed an issue with over writing the study system in probabilistic reliability assessment.
- Incorrect error messages could have been printed in multi-terminal dc bus and multi-terminal dc converter API routines.
- In activity BGEN, the mismatch message could be omitted when BGEN was unable to add a machine or load.
- Fixed an issue with area, owner, and zone subsystem selection in activities DIFF and DFTI.
- Removed ALL CAPCITORS or INDUCTORS are ON messages from SWSHNT and TWSHNT models.
- Fixed an issue with the maximum fault current calculated by GET_ASCC_MAXIF and GET_IECS_MAXIF APIs.
- Fixed an issue with invoking the CNTB API from the GUI.
- Fixed an issue with creating loading barcharts on three winding transformers.
- Fixed an issue with transformer annotation options being reset after being modified and saved.
- Fixed an issue with exporting a bus location file from a diagram that contained breakers or switches.
- Fixed an issue with floating the output bar and then restarting PSS®E.
- Fixed an issue with displaying Property Sheet dialogs for Fixed Shunts, Load, or Machines with combined values from a diagram.
- Fixed an issue with displaying the results of some branches on a diagram.
- Fixed an issue with path names containing apostrophes in response files and IPLAN programs from the GUI.

The following program errors have been detected and corrected in PSS®E-32.1:

- Performance enhancements to excelexport and n11analysis Python modules.
- Several corrections to OPF API Min/Max value checks and messages.
- Activity JOIN could crash when all of the following are true:
    - There is a non-zero line shunt on a branch connecting the buses being joined
    - JOIN is being run with the option to move such line shunts to the retained bus as fixed bus shunts
    - Neither of the buses being joined has a fixed bus shunt.
- Fixed an issue with limit checking in WT3G
- Fixed an issue with generating a contour of ASCC or IECS analysis

- Fixed several issues with the GNE (Generic Network Element) spreadsheet.
- When contingency cases failed to converge in any of the various ac contingency calculations, incorrect largest mismatches could have been reported.
- Several corrections to the Line Mode Interpreter (LMI)
    - Activity TLTG could get into an infinite loop
    - Bad input values for Switched Shunt data in activity SQCH
    - Bad display values in SQCH for Machine and Switched Shunt data

1.9 PSS®E-31

1.9.1 General

With the exception of the Power Flow Raw Data File format and the addition of a new data category at the end of the Sequence Data File, there is complete compatibility between PSS®E-30 and PSS®E-31 at the data input file level. That is, any other binary or source data file which could be successfully accessed by PSS®E-30 should also be able to be read by PSS®E-31.

The majority of PSS®E-31 activities and functions are identical in dialog to PSS®E-30. Dialog changes that have occurred as a result of new program features are described below (see New Features). Any Response Files and IPLAN programs used with PSS®E-30 that contain any of these line mode dialog streams and/or BAT_ commands need to be modified before they can be used in PSS®E-31.

- In activities READ, RDCH and TREA, the first record in the Case Identification Data, along with the Bus Data, Generator Data, Non-Transformer Branch Data, Two-Terminal DC Transmission Line Data, Multi-Terminal DC Transmission Line Data, Multi-Section Line Grouping Data, and FACTS Device Data record formats have been changed. A Fixed Bus Shunt Data category is added between the load and generator data categories. The Switched Shunt Data category is moved to the end of the input stream. Refer to Power Flow Raw Data File.

At PSS®E-31, provision is made for calling new sets of switched shunt models, and turbine load controller models from internal PSS®E tables; that is, the use of these models require no calls in subroutines CONEC and/or CONET. A new model type called the wind model type has been added to allow dynamic models to be created for those machines that are designated as wind machines in powerflow. Further, activity DYRE will not generate user model calls in connection subroutines USRXXX, USRLOD, USRREL, USRAUX, USRDCL, USRFCT (collectively called USRzzz functions). In fact, version 31 CONEC file will not have any of the USRzzz routines at all. User models, whose calls (in the pre-PSS®E-31 versions) were generated in these subroutines, will now be called from within PSS®E. However, conec file of earlier PSS®E versions that has the USRzzz subroutines would still work in PSS®E-31.

At PSS®E-31, the PSS®E-MATLAB interface feature of creating user defined dynamic models has been removed.

1.9.2 Fixed Bus Shunts

PSS®E-31 provides for multiple Fixed Bus Shunt Data, each of which is identified by a two-character shunt identifier. Each such fixed shunt has a status flag and provision for a complex positive sequence shunt admittance.

In fault analysis calculations, the negative sequence admittance is assumed to be identical to the positive sequence admittance, and a complex zero sequence admittance is specified in a new data category in the Sequence Data File (see *PSS®E Program Operation Manual*, Zero Sequence Fixed Shunt Data). In preparing and/or changing sequence data, note that:

- Negative sequence admittances corresponding to fixed bus shunts are assumed to be identical to their positive sequence values (see *PSS®E Program Operation Manual*, Fixed Bus Shunt Data) and therefore should *not* be included in the exceptional negative sequence shunt load admittance values (see *PSS®E Program Operation Manual*, Negative Sequence Shunt Load Data).
- Zero sequence admittances corresponding to fixed bus shunts (see *PSS®E Program Operation Manual*, Fixed Bus Shunt Data) are specified in the zero sequence fixed shunt data records (see *PSS®E Program Operation Manual*, Zero Sequence Fixed Shunt Data) and therefore should *not* be included in the zero sequence shunt load admittance values (see *PSS®E Program Operation Manual*, Zero Sequence Shunt Load Data).

This new capability has affected the formats of the Power Flow Raw Data File and the Sequence Data File.

The SHUNT array has been replaced with a SHUNT function. SHUNT(I), where I is a bus sequence number, returns the complex admittance of all in-service fixed shunts at the bus whose bus sequence number is I, Any user-written dynamics models which *change* bus shunt data need to be modified; those which only use this value in calculations may not require modifications.

1.9.3 Power Flow Raw Data File

The following are the changes to the Power Flow Raw Data File format:

- Four additional data items, REV, XFRRAT, NXFRAT and BASFRQ, are specified on the first record of the case identification data (see *PSS®E Program Operation Manual*, Case Identification Data).
- The bus shunt data items, GL and BL, are removed from the Bus Data record, and the OWNER data item is now specified between the ZONE and VM data items.
- A new category of data, Fixed Bus Shunt Data, is specified after the load data records and before the generator data records.
- Two additional data items, WMOD and WPF, are specified at the end of the Generator Data record for those machines which are wind machines.
- On the Non-Transformer Branch Data records, the identifier of the *to bus* is no longer preceded by a minus sign to indicate it as the metered end of the branch. Rather, an additional data item, MET, is specified between the ST and LEN data items to indicate metered end information.
- Two-Terminal DC Transmission Line Data, Multi-Terminal DC Transmission Line Data, and FACTS Device Data are now identified by a 12 character device name. If an unquoted numeric value is specified for the NAME data item, it is converted to a left-justified device name.
- On the dc link records of the Multi-Terminal DC Transmission Line Data record block, the identifier of the *to bus* is no longer preceded by a minus sign to indicate it as the metered end of the dc link. Rather, an additional data item, MET, is specified between the DCCKT and RDC data items to indicate metered end information.

- On the multi-section line grouping data records, the identifier of the *to bus* is no longer preceded by a minus sign to indicate it as the metered end of the multi-section line. Rather, an additional data item, MET, is specified between the ID and DUM1 data items to indicate metered end information (see *PSS®E Program Operation Manual*, Non-Transformer Branch Data).
- Two additional data items, REMOT and MNAME, are specified at the end of the FACTS Device Data record. MNAME is *required* for any FACTS device which is the slave device of an IPFC.
- The Switched Shunt Data category is now the last data category in the Power Flow Raw Data input stream.

The various power flow data input functions are now able to process Power Flow Raw Data Files which are in the format of a prior release of PSS®E (see *PSS®E Program Operation Manual*, Subsystem READ, Reading Power Flow Raw Data Files Created by Previous Releases of PSS®E, and Reading RDCH Data Files Created by Previous Releases of PSS®E). Several methods are available for utilizing old Response Files or IPLAN programs which read Power Flow Raw Data records in an old format.

For old automation files which read Power Flow Raw Data records via either a standard READ or a subsystem READ, the recommended method is to modify the input stream, either in the automation file itself or in the referenced Power Flow Raw Data File, as appropriate, so that the major revision number indicating the format of the data records is specified as the third data item on its first data record (see *PSS®E Program Operation Manual*, Subsystem READ, and Reading Power Flow Raw Data Files Created by Previous Releases of PSS®E). Alternatively, the ReadRawVersion API or the ReadSubRawVersion API, as appropriate, may be used. In this approach, the Power Flow Raw Data input stream is unchanged and the major revision number is specified as an input data item to the API,

For old automation files which read Power Flow Raw Data records using RDCH, the RdchRawVersion API, which is accessible either with the line mode command RDCH,OPT or via the BAT_RdchRawVersion command, may be used to process a Power Flow Raw Data File in RDCH input stream format (i.e., without the three case identification data records). If the input records are contained in the original automation file rather than in a referenced Power Flow Raw Data File, either the RDCH records must be moved to a Power Flow Raw Data File which must then be referenced in the command in the automation file which initiates the RdchRawVersion API, or the alternative technique using the VERSION command (see below) must be used.

For old automation files which read Power Flow Raw Data records using the line mode activity TREA, the data records are contained in the automation file in TREA input stream format (i.e., without the three case identification data records). The recommended method for reading TREA records is to use the technique using the VERSION command (see below).

An alternative approach to those described above includes the use of the new VERSION command of the Line Mode Interpreter (LMI). The VERSION command is specified with a single integer data value indicating a PSS®E major revision number. Modifying the input stream of the old automation file so that the data input command and any of its line mode input is preceded and followed by appropriate uses of the VERSION command allows old Power Flow Raw Data records to be read. For example, if the input stream contains the following two lines specifying the line mode READ activity command and the name of an input file which is in PSS®E-30 format:

```
READ
MYCASE30.RAW
```

the input stream may be modified to:

```
VERSION 30
READ
MYCASE30.RAW
VERSION 31
```

This technique is applicable to a standard READ, a subsystem READ, and activity RDCH, where the Power Flow Raw Data records may be contained either in a Power Flow Raw Data File or in the automation file itself. If is also applicable to activity TREA where the Power Flow Raw Data records must be contained within the automation file.

1.9.4 Sequence Data File

The following are the changes to the Sequence Data File format:

- The Zero Sequence Fixed Shunt Data category is added at the end of the Sequence Data input stream (see Section 1.9.2, Fixed Bus Shunts).

For old automation files which read Sequence Data records via RESQ, the recommended method is to modify the input stream, either in the automation file itself or in the referenced Sequence Data File, as appropriate, so that a Q is specified as the last record of the Sequence Data input stream.

For old automation files which read Sequence Data records using the line mode activity TRSQ, the data records are contained in the automation file in TRSQ input stream format (i.e., without the first data record which specifies the change code, IC). The recommended method for reading TRSQ records is to modify the input stream in the automation file itself so that a Q is specified as the last record of the Sequence Data input stream.

1.9.5 Line Mode

All dynamics activities are now implemented in the Line Mode Interpreter (LMI). GRPG has been implemented as well.

RDCH now accepts a suffix, OPT, which allows a version to be specified for the raw data file.

A new activity, VERSION, can be used to specify which version of the Line Mode “language” should be recognized. By default the current version is recognized. If an earlier value is entered, then the Line Mode responses that would have been appropriate for that version of PSS®E will be recognized. The only older (i.e. older than version 31) version that is implemented is 30.

At release 31.1.0 HELP,NEW can be used. ECHO can also be used, but only captures “terminal input”. The only such inputs in the PSS®E GUI are responses to prompts generated from IPLAN INPUT and INPUTLN calls, and the equivalent Python API calls.

1.9.6 Optimal Power Flow

The following changes have been made to the PSS®E OPF at release 31:

- The switched shunt error message is no longer output for voltage band controlled switched shunts that were changed from setpoint to continuous mode following an OPF solution.

- Error numbers returned from API calls to PURGE_OPF_LNCEQN_TRAN and PURGE_OPF_LNCEQN_BRFLOW have been reordered.

1.10 Simulation Model Library

1.10.1 New Models

The following models are added to the PSS®E simulation model library:

- AC7B, AC8B, DC4B, ST6B - New excitation system models proposed in the IEEE 421.5-2005 standard.
- PSS2B, PSS3B - New power system stabilizer models proposed in the IEEE 421.5-2005 standard.
- UEL2 - New under-excitation limiter model proposed in the IEEE 421.5-2005 standard.
- WT3G1 - Generic wind turbine model representing the Doubly Fed Induction Gnerator (Type-3 wind machine).
- WT3E1 - Generic electrical control model for the Type-3 wind machine.
- WT3T1 - Generic mechanical system model for the Type-3 wind machine.
- WT3P1 - Generic pitch control model for the Type-3 wind machine.

All the models can be used in the standard state-space simulations; the PSS2B model can be used in extended term simulations as well.

The following models (whose model calls are generated in CONET) have also been added to PSS®E simulation model library:

- FRQTPA - Under frequency generator disconnection relay model.
- FRQDCA - Under frequency generator bus disconnection relay model (disconnectes all equipments attached to the generator bus).
- VTGTPA - Under voltage generator disconnection relay model.
- VTGDCA - Under voltage generator bus disconnection relay model (disconnectes all equipments attached to the generator bus).
- OLPS3 - Online phase shifter model for three-winding transformers.
- OLTC3 - Online tap changer model for three-winding transformers.

1.10.2 Table Driven Models

At PSS®E-30, new sets of models for switched shunt, and the turbine load controllers have been developed which are called from internal PSS®E tables. This is similar to the approach used for plant-related, load related, line relay, auxiliary signal, dc line, and FACTS device models in that the use of these models do not require calls in subroutine CONEC and/or CONET. The new set of models supersedes the pre-PSS®E-30 set of CONEC and CONET models.

Each Dynamics Data Input File model data record referencing the old turbine load controller model (ULCFB1) or one of the old switched shunt models (CSSCS1, CHESVC, SWSHN1) is converted internally by activity DYRE to one of the corresponding new table-driven models. Activity DYRE notifies the user of each conversion that takes place. The new versions of these models do not require calls in CONEC and CONET; rather they are called from internal tables in the same manner that the other table-ized models are called.

The following table summarizes the conversion process:

Old Model	New Model
ULCFB1	LCFB1
CSSCS1	CSSCST
CHESVC	CHSVCT
SWSHN1	SWSHNT

In all cases, there is a one-to-one correspondence between the CON data list for the old model and the new model to which it is converted. In all cases, the ICON list between the old model and the new model to which it is converted is modified.

1.10.3 Elementary Blocks

In order to provide for an easy and a consistent method of handling transfer function STATE and DSTATE equations along with the associated non-windup limits in dynamic modeling, the concept of 'Elementary Blocks' has been introduced in PSS®E-31. The elementary blocks are a library of FORTRAN functions that can be invoked in dynamic models to initialize the STATE, for the calculation of DSTATE, to impose non-windup limits (if any), and to calculate the transfer function block output.

The following table summarizes the names of the FORTRAN functions for the various transfer function types that are used in dynamic models.

Table 1-1. FORTRAN Functions for Dynamic Model Transfer Types

Transfer function typel	FORTRAN function name (one for each MODE)
Integrator	INT_MODE1 INT_MODE2 INT_MODE3
Integrator with non-windup limits	NWINT_MODE1 NWINT_MODE2 NWINT_MODE3
First Order (lag)	LAG_MODE1 LAG_MODE2 LAG_MODE3
First Order lag with non-windup limits	NWLAG_MODE1 NWLAG_MODE2 NWLAG_MODE3
Washout	WSHOUT_MODE1 WSHOUT_MODE2 WSHOUT_MODE3
Lead-lag	LDLG_MODE1 LDLG_MODE2 LDLG_MODE3

Table 1-1. FORTRAN Functions for Dynamic Model Transfer Types (Cont.)

Transfer function typel	FORTRAN function name (one for each MODE)
Lead-lag with non-windup limits	NWLDLG_MODE1 NWLDLG_MODE2 NWLDLG_MODE3
Proportional-integrator (PI)	PI_MODE1 PI_MODE2 PI_MODE3
PI with non-windup limits	NWPI_MODE1 NWPI_MODE2 NWPI_MODE3
Proportional-integral-derivative (PID)	PID_MODE1 PID_MODE2 PID_MODE3
PID with non-windup limits	NWPID_MODE1 NWPID_MODE2 NWPID_MODE3
Second Order Block	ORD2_MODE1 ORD2_MODE2 ORD2_MODE3

A complete description of the use of the 'elementary blocks' functions is given in *Program Application Guide*, Chapter 22.

1.10.4 User-written Models

User-written DC Line and FACTS device models

In PSS®E-31, two-terminal dc lines, multi-terminal dc lines, and FACTS devices are now identified by 12 character device names. As a result, all user written DC line and FACTS device models that are called in CONEC and CONET, will need to be modified before being used in PSS®E-31, to change the way data structures are referenced internally in the models (user written dc line and FACTS device models whose calls were generated in the USRDCL and USRFCT connection routines need no modification).

Accessing PSS®E variables in user-written models

PSS®E user-written model codes should not make use of the FORTRAN USE statements to access PSS®E related variables in the user model codes. The only recommended approach to access PSS®E variables in user-written models is via the INCLUDE of COMON4.INS.

User-defined Models with IVF compiler

PSS®E-31 uses the Intel Visual Fortran (IVF) compiler. The way the IVF compiler treats uninitialized variables in model codes may be different from that of the Compaq Visual Fortran (CVF) compiler. As a result, user model codes that contain uninitialized variables may behave differently. Close attention in running cases with user-written models is therefore highly warranted.

1.10.5 New Features

The following new features are added at PSS®E-31.0:

- Multiple fixed bus shunts, each with its own status attribute, are implemented. These replace the complex bus shunt previously specified on the bus data record of the Power Flow Raw Data File (see Section 1.9.2, Fixed Bus Shunts and *PSS®E Program Operation Manual,* Fixed Bus Shunt Data*,* Zero Sequence Fixed Shunt Data, Negative Sequence Shunt Load Data, Zero Sequence Shunt Load Data).
- Machines in the power flow working case may be identified as wind machines. One of three reactive power boundary conditions for use in power flow solutions may be specified for each wind machine (see *PSS®E Program Operation Manual*, Generator Data).
- In specifying Transformer Data, a CW value of 3 provides for the specification of transformer tap settings (WINDVi), as well as their limits RMAXi and RMINi for voltage controlling transformer windings, in per unit of nominal winding voltages (NOMVi).
- The shunt element of a FACTS device may control voltage at a remote bus (see *PSS®E Program Operation Manual*, FACTS Device Data and Section 6.3.16, FACTS Devices).
- A switched shunt may be used to control the reactive power setting of the shunt element of a FACTS device (see *PSS®E Program Operation Manual*, Switched Shunt Data and Band Mode Voltage Control).
- For switched shunts

  a. which control voltage to a voltage band; and

  b. for which the voltage at the controlled bus is outside of the specified band:

  the new solution parameter SWVBND specifies the percentage of such switched shunts which can be adjusted on any single adjustment cycle (see *PSS®E Program Operation Manual*, Switched Shunt Adjustment and Automatic Adjustment Solution Parameters).
- Two-Terminal DC Transmission Line Data, Two-Terminal DC Transmission Line Data, and FACTS Device Data are now identified by 12 character device names in the same manner as are VSC dc lines.
- The convention of preceding the identifier of the to bus with a minus sign to indicate it as the metered end is replaced by a metered end data item on the Non-Transformer Branch Data, Multi-Terminal DC Transmission Line Data, and Multi-Section Line Grouping Data records of the Power Flow Raw Data File.
- The APIs for adding and modifying power flow and sequence data now report data additions and data changes in the progress area.
- In Newton solutions with values of TOLN greater than 1.0 and generator reactive limits applied automatically, the decision of when to apply VAR limits uses the same threshold that is used when TOLN = 1.0.
- A new PV Analysis engine, PV_ENGINE_2, provides for a different set of automatic adjustments enabled in contingency case transfer increment solutions than is enabled in base case transfer increment solutions.
- In the Contingency Description Data File read by activity DFAX, new contingency event records provide for changing the status of one winding of a three-winding transformer

such that one winding is out-of-service while the other two windings are in-service (see *PSS®E Program Operation Manual*, Contingency Case Block Structure).

- An automatic single tripping record can be specified in the Tripping Data File for specifying a series of single branch tripping events within a given subsystem. An additional unit 'PERCENT' for trip rating is provided; in using the keyword 'PERCENT', the trip rating is the percent of the designated rating set.
- A new function computes probabilistic indices of system problems such as branch overloads, bus voltage violations and voltage collapse. It can also calculate probabilistic load curtailment indices (see *PSS®E Program Operation Manual*, Section 6.15, Calculating Probabilistic Reliability).
- A new function implements a generation dispatch using the same dispatch algorithm that is used in contingency analysis. The dispatch may be imposed on the working case; alternatively, a designated contingency may be imposed on the working case and then the dispatch implemented (see *PSS®E Program Operation Manual*, Section 6.10.7, Implementing Generation Dispatch Algorithm in Contingency Analysis).
- The DFAX_CONTINGENCY api exports the contingency list contained in a Distribution Factor Data File, or builds multiple-level contingency list of up to N-3 by combining contingencies in multiple Distribution Factor Data Files. The results are output into a designated file (see *PSS®E Application Program Interface (API)*, Section 1.63, DCCOR).
- PSS™MUST .sub, .mon and .con files can be read into PSS®E; a file identifier PSS(tm)MUST must be in the first record in these files, and the record should be commented. Commands in PSS™MUST files that are not recognized by PSS®E are as follows:
  a. Commands with the option IN KVRANGE R1 R2 (in .con and .mon files)
  b. Automatic unit contingencies (e.g., SINGLE UNIT IN AREA i) (in .con files)
  c. ADD and SCALE commands (in .sub files)
  d. INCLUDE command (in .sub, .mon and .con files)
  e. FLOWGATE (in .mon files)
- Two new program option settings are recognized by the power flow reporting functions (POUT, LOUT, LAMP), the overload checking functions (RATE, RAT3, OLTR, OLTL), and the ac contingency analysis reporting functions. These provide for specifying the units of ratings and the calculation of percent loadings as either MVA or current. The non-transformer branch percent loading units setting applies to non-transformer branches, and the transformer percent loading units setting applies to transformers (see *PSS®E Program Operation Manual*, Saved Case Specific Option Settings, Case Identification Data, Non-Transformer Branch Data, and Transformer Data.)
- The three-winding transformer to bus reporting program option setting applies to the presentation of three-winding transformers in the reports of POUT, LOUT, LAMP and DCLF. Either they may be reported as they always have, or additional lines listing the buses connected to the other two windings of the transformer may be included.
- The out-of-service branch reporting program option setting applies to the presentation of out-of-service ac branches, dc lines, and FACTS devices in the reports of POUT, LOUT and LAMP. Either they may be omitted as they always have, or their output lines may be included with flows shown as XXX.

- Switched shunt error messages are no longer displayed after an OPF solution when any switched shunts initially set to discrete control are changed to continuous control by the OPF solution.
- OPF bus voltage limits that are adjusted as a result of the OPF Adjust bus voltage limits for feasibility option being enabled are now identified within the OPF output report by an (o) next to the expanded limit value.
- New OPF APIs are supplied for:

  Deleting participating branches and three-winding transformers from an OPF interface flow constraint.

  Deleting participating variables from an OPF linear constraint equation.

  Deleting a generator from an OPF period reserve constraint.

  See *PSS®E Application Program Interface (API)* Sections 3.2.65, 3.2.66, 3.2.68 through 3.2.77, and 3.2.81.
- The full list of updates and new features of the Optimal Power Flow are described in Section 2.2 Release 31.
- The maximum number of FACTS devices allowed is increased from 20 to 50 at size levels from 4,000 to 11,000 buses, from 40 to 100 at size levels from 12,000 and 49,000 buses, and from 99 to 250 at size levels of 50,000 buses and above. The maximum number of zones is increased from 2,000 to 9,999 at size levels of 50,000 buses and above (see *PSS®E Program Operation Manual,* Table 3-1 Standard Maximum PSS®E Program Capacities).
- The number of arguments that may be specified to Response Files has been increased from 9 to 15. In Response Files, the new arguments are referenced using the argument designator strings %10% through %15% (see *PSS®E Program Operation Manual*, Section 16.7, Argument Passing and Section 16.12, Running a Response File).
- Subsystem data retrieval routines are added for the following sets of data:

  Fixed shunt bus data.
  Fixed shunt data.
  Two-terminal dc line data.
  Two-terminal dc line converter data.
  Multi-terminal dc line data.
  Multi-terminal dc line converter data.
  VSC dc line data.
  VSC dc line converter data.
  FACTS device data.
  FACTS device bus data.
  Area data.
  Owner data.
  Zone data.

  See *PSS®E Application Program Interface (API),* Sections 8.8*,* 8.9, and 8.16 through 8.26*.*
- The PSS®E interface routines for use in Python and IPLAN programs include the following new routines: FXSINT, FXSDT1 and FXSDT2 return fixed bus shunt data; INIFXS/NXTFXS, INI2DC/NXT2DC, INIMDC/NXTMDC, INIVSC/NXTVSC, and INIFAX/NXTFAX are pairs of routines for looping through fixed shunts, two-terminal dc

lines, multi-terminal dc lines, VSC dc lines, and FACTS devices, respectively. The following are new versions of previously supplied routines in which the device whose data is to be returned is specified by its device name rather than a device number which was used for identification of two-terminal dc lines, multi-terminal dc lines, and FACTS devices in previous releases: DC2INT_2, DC2DAT_2, DCNINT_2, DCNCIN_2, DCNDAT_2, FCDINT_2, and FCDDAT_2. See *PSS®E Application Program Interface (API),* Chapter 7.

- The PSS®E interface routines for use in Python and IPLAN programs include the following new routines for use in dynamics (the routines ending with 'MIND' return the model index, while the 'MNAM' routines return the model name): DC2MIND and DC2MNAM for two-terminal dc lines; DCNMIND and DCNMNAM for multi-terminal dc lines; VSCMIND and VSCMNAM for VSC dc lines; FCDMIND and FCDMNAM for FACTS device; DC2AUXMIND and DC2AUXMNAM for auxiliary signal models associated with two-terminal dc lines; DCNAUXMIND and DCNAUXMNAM for auxiliary signal models associated with multi-terminal dc lines; VSCAUXMIND and VSCAUXMNAM for auxiliary signal models associated with VSC dc lines; FCDAUXMIND and FCDAUXMNAM for auxiliary signal models associated with FACTS device; SWSMIND and SWSMNAM for switched shunt; WINDMIND and WINDMNAM for wind machines. See *PSS®E Application Program Interface (API),* Chapter 7.
- New STRING values have been added to several PSS®E interface routines: YSZ in BUSDT1 and BUSDT2 returns the total in-service zero sequence fixed bus shunt at a bus; YSWZ in BUSDT1 and BUSDT2 returns the zero sequence switched shunt at a bus; WMOD in MACINT returns the wind machine reactive power limits mode (0 if the machine is not a wind machine); PERCENT in MACDAT returns the MVA loading of a machine as a percentage of its MVA base; WPF in MACDAT returns the power factor used in calculating reactive power limits for a wind machine whose WMOD is 2 or 3; PCTCPA, PCTCPB and PCTCPC in routines BRNMSC and WNDDAT return percent current or MVA loadings, according to the appropriate percent loading units program option setting, as a percentage of rating sets A, B and C, respectively; REMOTE in routines FCDINT and FCDINT_2 returns the bus number of the remotely controlled bus (0 if local control). See *PSS®E Application Program Interface (API),* Chapter 7.
- Python modules excelpy and pssexcel export PV and PV solution results to Excel spreadsheets.
- New sets of dynamic simulation Turbine Load Controller Models, Wind Generator Models, Wind Electrical Control Models, Wind Turbine Models, Wind Pitch Control Models), and Switched Shunt Models are supplied. These models are called from internal PSS®E tables; their use does not require calls in subroutines CONEC or CONET..
- New set of dynamic models, WT3G1, WT3E1, WT3T1 and WT3P1, to represent wind machines (i.e., machines that are designated as wind machines in power flow) and its controls are supplied. These are generic dynamic models representing the generator, electrical control, mechanical system, and the pitch control for wind machines of the doubly-fed induction generator type.
- The following new models from the IEEE 421.5-2005 standard are added to the PSS®E library: PSS2B, PSS3B, UEL2, AC7B, AC8B, DC4B, ST6B. The PSS2B and PSS3B are power system stabilizer models; UEL2 is an under-excitation limiter model; AC7B through ST6B are excitation system models. Other new models introduced are, OLTC3 and OLPS3 (dynamic models of on-load tap changing and phase-shifting 3-winding transformers); VTGTPA and VTGDCA (undervoltage generator and generator bus dis-

connection) models; FRQTPA and FRQDCA (underfrequency generator and generator bus disconnection) models. See *PSS®E Model Library*, Stabilizer Model Data Sheets, Minimum Excitation Limiter Model Data Sheets, Maximum Excitation Limiter Model Data Sheets, Excitation System Model Data Sheets, and CONEC and CONET Model Data Sheets.

- The ***Disturbance>Change Vref*** menu entry under the dynamic simulation creates a step change in the exciter reference voltage (VREF) without the need for writing code in CONEC (see *PSS®E Application Program Interface (API),* Chapter 4*)*.
- A new GUI method to compile and create user dll has been introduced. The user model source files that need to be compiled, as well as the object and library file names that may need to be included to create the user dll can be specified using the GUI. There is provision to 'compile', 'create DLL' or to 'compile and create DLL'.
- The PSS®E LineProp auxiliary program has the following new features:
  - There is now an option to output data in per unit based on a specified power system base and circuit voltage.
  - The full phase impedance and admittance matrices for the corridor are produced.
  - The full sequence impedance and admittance matrices for the corridor are produced.
  - Over 980 conductor/ground wires now defined in the LineProp library.
  - For more information reference the fully revised and enhanced *PSS®E LineProp Manual*.

The following new features are added at PSS®E-31.0.3:

- If PSS®E-30 and earlier Power Flow Raw Data Files are modified such that the first record includes the new data items added in version 31, the PSS®E-31.0.3 converter programs will read these values.
- The first data record of the case identification data written to PSS®E-30 and earlier Power Flow Raw Data Files created by either the PSS®E-31.0.3 previous version raw output or converter programs output includes the new data items added in version 31.

1.10.6 Optimal Power Flow

The following new features have been introduced into the PSS®E OPF module at release 31:

- OPF adjustable bus shunt identifiers have been increased to two characters in length to correspond to the new fixed shunt records in the loadflow.
- The OPF Adjustable Bus Shunt records interface with the new Multiple Fixed Shunt records in the loadflow data.
- Multiple Fixed Shunt records within the loadflow data network that have the same bus number and shunt ID as an OPF Adjustable Bus Shunt record will automatically be updated with the Var values of the OPF Adjustable Bus Shunt record following an OPF solution.
- If a corresponding Fixed Bus Shunt does not exist within the loadflow data, then a new Fixed Bus Shunt with the same bus number and shunt ID as the OPF Adjustable Bus Shunt will be added to the loadflow data with the B-shunt

MVar value assigned to the Var value from the corresponding OPF Adjustable Bus Shunt as determined by the OPF solution.

- The maximum number of allowable adjustable bus shunts represented in a PSS®E OPF working case has been set equal to the maximum number of fixed bus shunts allowed. This value is typically equal to the maximum bus size level at which PSS®E is invoked.

- Bus voltage limits that are adjusted as a result of the OPF Adjust bus voltage limits for feasibility option being enabled are now identified within the OPF output report by an (o) next to the expanded limit value.

- The OPF solution now gracefully exits if an Empty OPF solution space error is encountered due to a single bus system.

- Two new Response file commands have been added for deleting participating branches and three winding transformers from an OPF interface flow constraint: PURGE_OPF_INTFLW_BRN and PURGE_OPF_INTFLW_3WT.

- The PURGE_OPF_PERRSV_GEN Response file command has been added to remove a participating generator from an OPF period reserve constraint.

- Ten new Response file commands have been added for deleting participating variables from and OPF linear constraint equation:

  PURGE_OPF_LNCEQN_VMAG, PURGE_OPF_LNCEQN_VANG, PURGE_OPF_LNCEQN_PGEN, PURGE_OPF_LNCEQN_QGEN, PURGE_OPF_LNCEQN_TRAN, PURGE_OPF_LNCEQN_BRFLOW, PURGE_OPF_LNCEQN_INTFLOW, PURGE_OPF_LNCEQN_ADJVAR, PURGE_OPF_LNCEQN_SWSHUNT, PURGE_OPF_LNCEQN_ADJLOAD.

1.10.7 Program Corrections

The following program errors have been detected and corrected in PSS®E-31.0:

- In the switched shunt model CSSCS1, the continuous control (i.e., the state variables in the model) was not updated to match the SVC output when a transition into the discontinuous mode (determined by the parameter VOV) occurs. As a result, during a transition from the discontinuous mode (from VOV action) to the continuous mode, there could be abrupt change in the SVC output. In weak systems, the change could be large enough to affect the voltage and push the control back to the discontinuous mode, causing numerical oscillation.
- In the DC line model CDCVUP, the program logic accessed a set of arrays before they were allocated. As a result, PSS®E would crash during initialization phase.

The following program errors have been detected and corrected in PSS®E-31.0.1:

- In multiple level contingency analysis, when the dispatch mode was enabled and perform multiple level contingency analysis option was not checked, PSS®E would crash.
- PSS®E was unable to read an OPF options file which was created by revision 31.

The following program errors have been detected and corrected in PSS®E-31.0.2:

- Incorrect values of magnetizing admittance contributions for three-winding transformers may have been used in accumulating line shunt totals in the area and zone summary totals reports (activities AREA and ZONE).
- In P-V analysis, when switched shunts were adjustable in base case transfer increment solutions but not in contingency case transfer solutions, the base case switched shunt settings at a given transfer level were not picked up correctly as the starting point for the contingency case solution at that transfer level.
- Temporary files created by PSS®E during an application were not deleted after the application was done under some circumstances (e.g., performing multiple ACCC runs from a Response File).
- Unable to edit IEEEG1 governor model CONs in version 31.0 and 31.0.1; got a message that model is IEEEG1 and not IEEEG1.
- Output of the turbine-load controller model ULCFB1 (called in CONEC) had no effect on the governor model input in PSSE-31.0 and 31.0.1.

The following program errors have been detected and corrected in PSS®E-31.0.3:

- In BRCH, GCAP, GEOL, OUTS, RATE (OLTR, OLTL, RAT3), and TLST, equipment items could have been omitted from the report when all of the following conditions were satisfied:
  - the equipment has provision for its own area, owner, and/or zone assignment (i.e., it does not inherit one or more of these attributes from the bus or buses to which it is attached).
  - subsystem specification by one or more of these attributes was specified.
  - the equipment is assigned to an area, owner, and/or zone which has no buses assigned to it.
- In accessing a rev 30 or earlier Saved Case or Power Flow Raw Data File containing an IPFC, the master name field (MNAME) of the slave FACTS device was blank rather than containing the name of the master FACTS device.

1.11 PSS®E-30

1.11.1 General

With the exception of the Power Flow Raw Data File and Other Input Files in which buses may be specified using their extended bus names, there is complete compatibility between PSS®E-29 and PSS®E-30 at the data input file level. That is, any other binary or source data file which could be successfully accessed by PSS®E-29 should also be able to be read by PSS®E-30.

At PSS®E-30, provision is made for calling new sets of dc line models, FACTS device models, and their auxiliary signal models from internal PSS®E tables; that is, the use of these models requires no calls in subroutines CONEC and/or CONET. Further, additional statements that were needed in CONEC to place the auxiliary-signal VAR into the dc line and FACTS device other signal VAR, are no longer required. Nonetheless, a dynamics setup used in PSS®E-29 is able to be used in PSS®E-30 almost without any change. Dynamic simulation snapshot files from PSS®E-20 through PSS®E-29 can be read by PSS®E-30.

Other than the addition of the USRAUX, USRDCL, and USRFCT routines (see Simulation Model Library), a dynamics setup used in PSS®E-29, PSS®E-28 or PSS®E-27 is able to be used in

PSS®E-30 without change. The connection routines (CONEC, CONET, USRXXX, USRLOD and USRREL) and user-written models used in PSS®E-29, PSS®E-28 or PSS®E-27, along with the new USRAUX, USRDCL, and USRFCT routines, need only be recompiled.

The connection routines and user-written models used in PSS®E-26 also require the addition of the USRREL routine (see Dynamic Simulation of the PSS®E-27 update notes below); the connection routines and user-written models used in PSS®E-25 also require the addition of the USRLOD routine (see Dynamic Simulation of the PSS®E-26 update notes below); those used in PSS®E-20 through PSS®E-24 may require additional minor modifications (see CONEC, CONET, and User Models of the PSS®E-25 update notes below). To access simulation setups from PSS®E-19 or earlier, see the PSS®E-20 update notes below. While a mid-run Snapshot File written by PSS®E-22 or earlier may be accessed with activity RSTR of PSS®E-30, it may not be used for the purpose of continuing the interrupted run; the entire simulation must be executed.

At PSS®E-30 the BMATRIX program section is no longer supplied.

The majority of PSS®E-30 activities and functions are identical in dialog to PSS®E-29. Dialog changes that have occurred as a result of new program features are described below (see New Features). Any Response Files and IPLAN programs used with PSS®E-29 that contain any of these line mode dialog streams and/or BAT_ commands need to be modified before they can be used in PSS®E-30.

- In activities READ, RDCH and TREA, the switched shunt, FACTS device and three-winding transformer data record formats have been changed. Refer to Power Flow Raw Data File and Other Input Files.
- In activities READ,NAME, RDCH,NAME and TREA,NAME, any extended bus names in the input stream must be converted so as to recognize the widening of bus names from 8 to 12 characters. Refer to Power Flow Raw Data File and Other Input Files.
- In specifying buses with the bus input program option setting in its names mode (see *PSS®E Program Operation Manual*, Section 3.3.3, Program Run-Time Option Settings), extended bus names must be converted so as to recognize the widening of bus names from 8 to 12 characters. Refer to Power Flow Raw Data File and Other Input Files.
- In the BAT_SWITCHED_SHUNT_DATA command, the dimension of the REALAR array is increased from 11 to 12 in order to accommodate the new RMPCT data item. Refer to Power Flow Raw Data File and Other Input Files and the *PSS®E Application Program Interface (API)* manual.
- In the BAT_FACTS_DATA command, the dimension of the REALAR array is increased from 12 to 13 in order to accommodate the new RMPCT data item. Refer to Power Flow Raw Data File and Other Input Files and the *PSS®E Application Program Interface (API)* manual.
- In changing switched shunt data in activity CHNG, the new RMPCT data item is inserted between the controlled bus number and the VSC dc line name data items in numbers input mode, and between the present switched shunt admittance and the VSC dc line name data items in names input mode.
- In changing three-winding transformer data in activity CHNG, two additional groups of data, adjustment data for windings two and three, are presented for possible modification by the user. These appear before the final group of data, the ownership data.

- In executing activity DIFF in line mode, an additional prompt to specify the transformer ratio and angle thresholds is issued when the transformer difference check is selected. In the BAT_DIFF command, THRESH(2) and THRESH(3) are the ratio and angle thresholds, respectively, when APIOPT is 2 and STATUS(2) is 22.
- In the BAT_ECDI command, new APIOPT values are introduced. While the format of the command is unchanged, the number of consecutive references required is changed. Refer to the *PSS®E Application Program Interface (API)* manual.
- In the BAT_DCLF command, the dimension of the STATUS array is increased from 3 to 4 in order to accommodate the user's specification of a continue/abort selection when the initial active power mismatch exceeds 0.5 MW. Refer to the *PSS®E Application Program Interface (API)* manual.
- The graphical output of activity POLY is now available only in the new interface. In the BAT_POLY command, an additional data item to specify a Results output file is required. Refer to the *PSS®E Application Program Interface (API)* manual.
- In the BAT_SEQ_TWO_WINDING_DATA command, the dimension of the REALAR array is increased from 4 to 6 in order to accommodate the new winding two side grounding impedance when the connection code is 8. Refer to the *PSS®E Application Program Interface (API)* manual.
- In the BAT_SEQD command, the dimension of the OPTIONS array is reduced from 3 to 2; the old usage of the OPTIONS(1) entry is removed since there is no longer a double precision option (see New Features). Refer to the *PSS®E Application Program Interface (API)* manual.
- Similarly, in the BAT_SCMU command when APIOPT is 1, the first 2 rather than the first 3 elements of the OPTIONS array are used; the old usage of the OPTIONS(1) entry is removed since there is no longer a double precision option (see New Features) Refer to the *PSS®E Application Program Interface (API)* manual.
- The format of the ASCC Relay Output File has been modified as a result of the wider bus number and name fields. Results for winding faults of three-winding transformer windings are now included. See *PSS®E Program Operation Manual*, Section 10.8, Calculating Automatic Sequencing Fault.
- In activities DOCU and DYDA, the numeric response codes in the model type selection prompt for CONEC models and CONET models (and CHAN models in activity DOCU) have each been increased by five. Corresponding changes have been made in the values used in the STATUS(3) value passed to the BAT_DOCU command and in the STATUS(2) value passed to the BAT_DYDA command.
- Four PSS®E option setting commands introduced at PSS®E-29 have had their names changed as follows:

  BAT_AREA_INTERCHANGE_CONTROL to BAT_CONTROL_AREA_INTERCHANGE;
  BAT_SIZE_LEVEL to BAT_BUS_SIZE_LEVEL;
  BAT_SAVE_OPTION_SETTINGS to BAT_WRITE_OPTIONS_FILE; and
  BAT_MULTISECTION_LINE_REPORTING to BAT_MULTISECTION_REPORTING.
- The following load flow data changing commands have had their names changed as follows:

  BAT_TWO_TERMINAL_DC_CONVERTER_DATA to BAT_TWO_TERM_DC_CONVR_DATA;

BAT_VSC_DC_LINE_CONVERTER_DATA to BAT_VSC_DC_CONVERTER_DATA; BAT_MULTI_TERMINAL_DC_BUS_DATA to BAT_MULTI_TERM_DC_BUS_DATA; BAT_MULTI_TERMINAL_DC_CONVERTER_DATA to BAT_MULTI_TERM_DC_CONVR_DATA; BAT_MULTI_TERMINAL_DC_LINE_DATA to BAT_MULTI_TERM_DC_LINE_DATA; and BAT_MULTI_TERMINAL_DC_LINK_DATA to BAT_MULTI_TERM_DC_LINK_DATA.

1.11.2 The Line Mode Interpreter

The new GUI for PSS®E Power Flow does not use the Line Mode input that has been present in previous versions of PSS®E, and is still used in PSS®E Dynamics. A new version, called the Line Mode Interpreter (LMI) is used. Differences in design between the two are documented in a separate section, Line Mode and Line Mode Interpreter Compatibility. In this first release of the LMI only Power Flow activities are included. The activities HELP, ECHO, DRED, GRED, and GRPG are not implemented. IDEV, EXEC and immediate (@) commands will only work from automation files and not interactively. PSAS and PSEB will only work in CHECK mode interactively.

1.11.3 Power Flow Raw Data File and Other Input Files

The following are the changes to the Power Flow Raw Data File format:

- The Switched Shunt Data record contains an additional data item. An RMPCT field is inserted between the SWREM and RMIDNT fields.
- The FACTS Device Data record contains an additional data item. An RMPCT field is inserted between the LINX and OWNER fields.
- The fourth and fifth records of the three-winding Transformer Data input block have been extended to accommodate adjustment data for the windings two and three. Their formats are identical to that of the third record which contains data that applies to winding one.

In the *PSS®E Program Operation Manual* Setpoint Voltage Control describes the use of the new RMPCT data items described above.

In addition, any Power Flow Raw Data File or any Response File containing power flow raw data input records in which extended bus names are specified (i.e., they require the names input option of activity READ, TREA or RDCH) need to have each extended bus name modified to reflect the increase in bus name width from 8 to 12 characters (see *PSS®E Program Operation Manual*, Section 5.2.1, Power Flow Raw Data File Contents, Section 5.7, Reading / Changing Power Flow Data, and Section 5.4.1, Machine Impedance Data File Contents). That is, old extended bus names consisted of the 8-character bus name followed by up to 6 characters containing the bus base voltage; new extended bus names consist of the 12 character bus name followed by up to 6 characters containing the bus base voltage. Thus, old extended bus names are converted to new extended bus names by inserting four blanks between the old 8 character name and the base voltage field.

A format conversion program, CNV30, is supplied with PSS®E-30 (see *Additional Resources for PSS®E*). It converts Power Flow Raw Data Files from the format required in PSS®E-29 to that required in PSS®E-30. CNV30 includes provision for expanding extended bus names to the form required by PSS®E-30.

Similarly, in using Response Files, IPLAN programs, and several data input files when the PSS®E bus input option is at its names setting, bus identifiers are either allowed or required to be specified as extended bus names (see *PSS®E Program Operation Manual,* Section 3.3.3, Program Run-Time Option Settings). Data input files to which this applies include Dynamics Data Files used by activity DYRE, Linear Network Analysis Data File used by activities DFAX and RANK, Drawing Coordinate Data Files used by activities DRED, GDIF and SCGR, PSEB and PSAS Command Files used by activities PSEB and PSAS respectively, and Graphical Report Definition Files used by activity GRPG. Such input files may be brought up to the form required by PSS®E-30 by manually editing them to insert four blanks between the name and base voltage portions of any extended bus names.

Alternatively, PSS®E-30 includes provision for *temporarily* instructing the extended bus name search routine to accept as input the extended bus name form used at PSS®E-29 and earlier releases (eight character alphanumeric bus name plus up to six characters containing the bus base voltage), and then convert it to the PSS®E-30 form by inserting four blanks between the name and base voltage portions of the PSS®E-29 extended bus name. The extended bus name form flag may be placed in either the PSS®E-29 or PSS®E-30 setting by using:

- the BAT_REV29_NAMES batch command; or
- the ***Misc>Select extended bus name input format*** menu entry

When PSS®E-30 is started up, the extended bus name form flag is always set to its standard PSS®E-30 setting. To use a Response File, IPLAN program, or one of the data input files listed above which uses the PSS®E-29 form of extended bus names, the following approach may be used:

- Place the extended bus name form flag in its PSS®E-29 setting by using the batch command or menu entry listed above.
- Execute the Response File, IPLAN program, or data input activity.
- Place the extended bus name form flag back in its PSS®E-30 setting by using the batch command or menu entry listed above. **Do not omit this step.**

This approach should always be successful for the processing of data input files. However, the execution of Response Files and IPLAN programs should be checked to verify that they behaved as intended.

1.11.4 Optimal Power Flow

The following changes have been made to the PSS®E OPF at release 30:

- The CNVOPF auxiliary program is no longer supplied.
- The INTGAR and REALAR values in the following OPF BAT_ commands have been condensed and/or reordered for easier entry and consistency. Commands within Response files generated with previous releases of the program will need to be updated, or the Response file regenerated.
    - BAT_OPF_ADJBRX_INDV, BAT_OPF_ADJBRX_SUBSYS,
    - BAT_OPF_ADJVAR_INDV, BAT_OPF_ADJVAR_SUBSYS,
    - BAT_APDSP_TBL,
    - BAT_BRFLW_3WT_INDV, BAT_BRFLW_BRN_INDV,
    - BAT_BRFLW_SUBSYS,
    - BAT_BUS_INDV, BAT_BUS_SUBSYS,

- BAT_GEN_RCAP_INDV, BAT_GEN_RCAP_SUBSYS,
- BAT_GENDSP_INDV, BAT_GENDSP_SUBSYS,
- BAT_INTFLW_MAIN

1.11.5 Simulation Model Library

New Models

The following models are added to the PSS®E simulation model library:

- GGOV1 is a general purpose turbine-governor model.
- VSCDCT is a VSC dc line model.
- The CIM6BL/CIM6OW/CIM6ZN/CIM6AR/CIM6AL model family is an induction motor model with both motor starting capability (as in the CIM5xx model family) and detailed load torque representation (as in the CIMWxx model family).

The GGOV1 and CIM6xx models may be used in both state space and extended term simulations; the VSCDCT model may not be used in extended term simulations.

Table Driven Models

At PSS®E-30, new sets of models for dc line, FACTS device, and their auxiliary-signal models have been developed which are called from internal PSS®E tables. This is similar to the approach used for plant-related, load related, and line relay models in that the use of these models do not require calls in subroutine CONEC and/or CONET. The new set of models supersedes the pre-PSS®E-30 set of CONEC and CONET models.

Each Dynamics Data Input File model data record referencing one of the old dc line and FACTS device models is converted internally by activity DYRE to one of the corresponding new table-driven dc line and FACTS device models respectively. Activity DYRE notifies the user of each conversion that takes place. The new versions of these models do not require calls in CONEC and CONET; rather they are called from internal tables in the same manner that the other table-ized models are called.

The following table summarizes the conversion process:

Old Model	New Model
CDC1	CDC1T
CDC4	CDC4T
CDC6	CDC6T
CDC6A	CDC6TA
CDCAB1	CDCABT
CEELR2	CEEL2T
CEEL	CEELT
MTDC01	MTDC1T
MTDC03	MTDC3T

Old Model	New Model
CSTCON	CSTCNT

In all cases, there is a one-to-one correspondence between the CON data list for the old model and the new model to which it is converted. In all, except in the FACTS device model CSTCNT, the ICON list between the old model and the new model to which it is converted is modified. The old model set for CDC1, CDC4, CDC6, CDC6A, CDCAB1, CEELR2, CEEL, MTDC01, and MTDC03 contained ICON space for PSS®E internal memory. In the table-ized model, this has been removed from the ICON data list. Hence while using the corresponding new models CDC1T, CDC4T, CDC6T, CDC6TA, CDCABT, CEEL2T, CEELT, MTDC1T, and MTDC3T, the user need not input ICON data for memory.

Unlike in the case of dc lines and FACTS devices, each Dynamics Data Input File model data record referencing one of the old auxiliary-signal models is not converted internally by activity DYRE to the corresponding new table-driven model. The reason for this is that the auxiliary-signal models in the table-driven form require additional data to be input in the Dynamics Data Input File. Activity DYRE notifies the user to convert the old auxiliary-signal model name to the corresponding new model.

The following table lists the correspondence between the old and new auxiliary-signal model names.

Old Model	New Model
CPPAUX	CPPAUT
DCVREF	DCVRFT
PAUX1	PAUX1T
PAUX2	PAUX2T
SQBAUX	SQBAUT
CHAAUX	CHAAUT
DCCAUX	DCCAUT
HVDCAU	HVDCAT
RBKELR	RBKELT

In all cases, there is a one-to-one correspondence between the CON data list for the old model and the new model to which it is converted. In all cases, except in RBKELR model, there is a one-to-one correspondence between the ICON data list for the old model and the new model to which it is converted. Model RBKELR contained ICON space for PSS®E internal memory. In the table-ized model, this has been removed from the ICON data list. Hence while using the corresponding new model RBKELT, the user need not input ICON data for memory.

At PSS®E-30, two options for handling dynamic simulation setups from PSS®E-29 which include calls in CONEC and/or CONET to any of the old dc line, FACTS device, or auxiliary-signal models listed above are available:

1. The old setup may be used. The only change required is the addition of the following codes to the bottom of the file containing the FLECS code of subroutine CONEC:

```
SUBROUTINE USRAUX(IDVX, IDVT, ISGX, SLOT, IT)
INTEGER IDVX, IDVT, ISGX, SLOT, IT
SELECT (IT)
(OTHERWISE) CALL UAALRM(IDVX, IDVT, ISGX,IT)
FIN
RETURN
END
SUBROUTINE USRDCL(IDC, SLOT, IT)
INTEGER IDC, SLOT, IT
SELECT (IT)
(OTHERWISE) CALL UDALRM(IDC, IT)
FIN
RETURN
END
SUBROUTINE USRFCT(NF, SLOT, IT)
INTEGER NF, SLOT, IT
SELECT (IT)
(OTHERWISE) CALL UFALRM(NF, IT)
FIN
RETURN
END
```

Then the modified CONEC file, the original CONET file, and any user-written models used in the simulation need to be recompiled, and PSS®E relinked. Using this approach, dynamic simulations are executed using the old auxiliary-signal, dc line and FACTS device models called from subroutines CONEC and CONET.

The file conec.flx in the PSS®E Example subdirectory contains the default version of the USRAUX, USRDCL, and USRFCT subroutines as well as those of USRXXX, USRLOD and USRREL subroutines.

2. Proceed as if the old setup is to be used as above. Pick up the old Snapshot File and use activity DYDA to produce a Dynamics Data Input File, which will include data records for the models. There are two possible cases:

   - If the case does not have any old auxiliary-signal models, use activity DYRE to read the Dynamics Data Input File. If there are old dc line and FACTS device models, activity DYRE internally converts the old model data records to models from the new set.
   - If the case has old auxiliary-signal models, the auxiliary-signal model records in the Dynamics Data Input File created as a result of activity DYDA need to be edited. If the old auxiliary-signal model is any one of the following: CPPAUX, DCVREF, PAUX1, PAUX2, CHAAUX, DCCAUX, or HVDCAU, the Dynamics Data Input File created as a result of activity DYDA would have the corresponding new model names, and would look as follows:

     ```
     **DevId   ' New Model Name'    **DevType     **AuxIndex    data items /
     ```

     This has to be edited to specify the device number (for two-terminal dc, multi-terminal dc, and FACTS device) or device name in single quotes for VSC dc line in place of **DevId, the device type in place of **DevType, and the auxiliary signal index (or the signal injection point) in place of **AuxIndex.

     If the old auxiliary-signal model is any one of the following: SQBAUX or RBKELR (these can be used only with two-terminal dc line models), the Dynamics Data Input File created as a result of activity DYDA would already have the device index, the device type (which is 1 for two-terminal dc lines), and the corresponding new model name. The only editing that would be needed is to specify the auxiliary signal index (or the signal injection point) in place of **AuxIndex.

In addition to editing the data records corresponding to the auxiliary-signal models as described above, DYRE data records for user-written models of auxiliary-signals, dc lines and FACTS devices will have to be edited to use the corresponding new DYRE data categories (USRAUX, USRDCL, and USRFCT - this implies that user-written model codes for auxiliary-signals, dc lines, and FACTS devices need to be modified to ensure that model subroutine arguments are compatible with the model call arguments generated by PSS®E). Then use activity DYRE to read the Dynamics data Input File. If there are old dc line and FACTS device models, activity DYRE internally converts the old model data records to models from the new set.

Dynamics memory should then be preserved with activity SNAP, the new CONEC and CONET files recompiled, any user-written models used in the simulation recompiled, and PSS®E re-linked.

PTI recommends that the second procedure, or an equivalent variant thereof, eventually be employed. The old models are considered obsolete and will be removed from PSS®E at a future program release.

Multi-terminal dc line model MTDC02 in pre-PSS®E-30 versions was not recognized by activity DYRE, and the call to this model had to be introduced manually in CONEC and CONET. At PSS®E-30, this model is called MTDC2T, and is a standard model that is recognized by activity DYRE. The new model does not require calls in CONEC and CONET; rather it is called from internal PSS®E tables.

1.11.6 User-Written Two-Machine Models

Any user-written cross-compound governor or other two-machine models need to be modified in the method used to unpack the machine indices from the MACNUM array. The machine index of the high pressure (or first) machine is unpacked via a statement such as:

```
K1=IBITS(MACNUM(ISLOT),0,16)
```

and the machine index of the low pressure (or second) machine is obtained via a statement such as:

```
K2=IBITS(MACNUM(ISLOT),16,16)
```

where IBITS is the FORTRAN intrinsic function for extracting consecutive bits from an integer variable, and ISLOT is the second argument of the model's SUBROUTINE statement (see *PSS®E Program Operation Manual,* Sections 21.4 and 21.6).

1.11.7 New Features

The following new features are added at PSS®E-30.0:

- PSS®E now allows six digit bus numbers (through 999997). In addition, bus, area, zone, owner, transformer, dc bus, and VSC dc line names have been increased from eight to twelve characters. As a result, all report formats have been modified, some drastically (for example, activities LIST and SQLI have additional data categories).
- Two additional control strategies for switched shunts have been implemented. Remote voltage control to a setpoint by switched shunts is now allowed. A switched shunt may be used to control the reactive power setting of another switched shunt (see *PSS®E*

Program Operation Manual, Switched Shunt Data, Switched Shunt Devices, and Switched Shunt Adjustment).

- Multiple setpoint mode voltage controlling devices (generation, switched shunts, VSC dc line converters, and the shunt elements at the sending end of FACTS devices) are allowed on the same bus and on buses connected by zero impedance lines. Similarly, different types of setpoint mode voltage controlling devices connected to the same or different buses may be controlling the same bus voltage (see *PSS®E Program Operation Manual,* Setpoint Voltage Control).
- An RMPCT data item is now associated with switched shunts and FACTS devices. See Section 1.11.3, Power Flow Raw Data File and Other Input Files and *PSS®E Program Operation Manual,* Owner Data, FACTS Device Data, and Setpoint Voltage Control.
- Any or all windings of three-winding transformers may be specified as being automatically adjusted during power flow solutions. See Section 1.11.3, Power Flow Raw Data File and Other Input Files and *PSS®E Program Operation Manual,* Transformer Data.
- In the Area Interchange Control monitor of the power flow solution activities, slack bus active power limits are now listed. Further, if an old or new active power setting is outside of its active power limits, the active power is followed by an asterisk (*).
- The AC Contingency Solution (ACCC) now processes the SET, CHANGE, INCREASE, DECREASE, MOVE and ADD contingency events. See See *PSS®E Program Operation Manual,* Single Run Report Formats.
- In reporting two-winding transformers in activities POUT, LOUT and LAMP, the winding two tap ratio, rather than the winding one tap ratio and phase shift angle, is printed in the output block of the winding two bus (i.e., when the winding two bus is the *from bus*). That is, the tap settings reported are always those adjacent to the bus being reported.
- In activity DIFF, windings of three-winding transformers are included in the branch related checks. In the transformer check, the user may now specify difference thresholds for reporting ratio and angle differences.
- In activity BRCH, ratings are included in the output of the parallel transformer report.
- In the new interface, the Optimal Power Flow (OPF) is able to import an Economic Dispatch Data File, as used by activity ECDI, into the OPF cost curve data structure.
- The fault analysis activities SEQD, SCMU, ASCC, SCGR and SPCB now use double precision arithmetic for their fault calculations. These calculations are much faster than the old double precision option of activities ASCC, SCGR and SEQD,DP.
- The flat option of activities ASCC and SCGR no longer uses a matrix modification technique, which would occasionally fail, for calculating line out and line end faults.
- The ***Disturbance>Calculate and Apply Branch Unbalance*** menu entry of the dynamic simulation activity selector calculates and applies a single branch unbalance. The unbalance calculation is identical to that of activity SPCB.
- Commands have been added to activities PSEB and PSAS for changing the status of three-winding transformers. Activity PSAS also has a command for placing three-winding transformer quantities into output channels.
- New sets of dynamic simulation models for dc lines, FACTS devices, and their auxiliary signal devices are supplied. These models are called from internal PSS®E tables; their use does not require calls in subroutines CONEC or CONET. See PSS®E *Program*

Operation Manual, FACTS Device Model, Wind Generator Models, and Wind Electrical Control Models.

- The Dynamics Data Input File of activity DYRE recognizes USRDCL, USRFCT and USRAUX data records on which user-written models for dc lines, FACTS devices, and their auxiliary signal devices types may be specified. See Section , Table Driven Models and PSS®E *Program Operation Manual*, User-Written Models.
- The following models are added to the PSS®E library: GGOV1, VSCDCT and CIM6xx. The GGOV1 and CIM6xx models may be used in both state space and extended term simulations; the VSCDCT model may not be used in extended term simulations. The model GGOV1 is a general purpose turbine-governor model. VSCDCT is a VSC dc line model. The CIM6BL/CIM6OW/CIM6ZN/CIM6AR/CIM6AL model family is an induction motor model with both motor starting capability (as in the CIM5xx model family) and detailed load torque representation (as in the CIMWxx model family).
- PSS®E now has a MATLAB interface connection (PMSI) which allows user-defined excitation system and turbine-governor models to be created in SIMULINK. The Dynamics Data Input File of activity DYRE recognizes USRMAT data records on which MATLAB-SIMULINK user-written models of these equipment types may be specified.
- The maximum bus dimensional capacity has been increased to 150,000 buses. The maximum number of areas, owners, and zones which may be represented has been increased to 1,200, 1,200, and 2,000, respectively, at size levels of 50,000 buses and above.
- Two new auxiliary programs have been added: CNV30 converts a PSS®E-29 Raw Data File to a Raw Data File in the form required by PSS®E-30; RAW29 outputs a PSS®E Saved Case in PSS®E-29 Raw Data File form. See *Additional Resources for PSS®E*.
- The PSS®E interface routines for use in IPLAN programs include several new subroutines. The SWSDT1 subroutine returns floating point data of switched shunts. SC3WND may be used to access short circuit currents on three-winding transformer windings following a fault calculation by activity SCMU. AREUSE, ZONUSE and OWNUSE indicate if any equipment is assigned to a specified area, zone or owner, respectively. Further, several new STRING values are recognized by subroutines XFRDAT, DC2DAT, DCNDAT and FCDDAT. See *IPLAN Program Manual*.
- Updates and new features of the Optimal Power Flow are described in Section 2.3 Release 30.

The following new features are added at PSS®E-30.1:

- An additional switched shunt adjustment option is available: adjust continuous mode switched shunts (control mode is 2) but lock discrete mode switched shunts (control mode is 1, 3, 4 or 5). This is available in the standard power flow solution activities, as well as in the inertial load flow, the ac contingency solution function, the PV calculation function, and the QV calculation function.
- Activity FDNS is terminated if the voltage magnitude at any bus is driven close enough to 0.0 to cause numerical problems (e.g., exponential overflow).
- In reporting branch loadings from the AC Contingency Solution, the PV calculation, and the QV calculation, if the current loadings are equal at each end, the end with the higher MVA loading is the one from which the loading conditions are taken.

- A function for reporting the results of up to 9 AC Contingency Solution calculations simultaneously is added. It is accessible via the ***Power Flow>Reports>Multiple AC Contingency Solution report*** menu entry in the new interface or via the PP_ACCC_MULTI_CASE api.
- In the append ACCC function (accessible via the ***Power Flow>Reports>Append to AC Contingency solution output file*** menu entry in the new interface or via the APPEND_ACCC api), the number of characters allowed in each of the contingency descriptor input lines is increased to 120.
- In the PV analysis calculation (accessible via the ***Power Flow>Solution>PV analysis*** menu entry in the new interface or via the PV_ENGINE api), the method for modifying the transfer to approach the transfer limit has been changed to a binary search technique. The small transfer increment data item has been replaced by a transfer increment tolerance data item.
- A function is added for implementing a transfer between a study (source) system and an opposing (sink) system. It uses the same transfer dispatch methods that are available in PV analysis calculation, and is accessible via the ***Power Flow>Solution>Implement PV transfer*** menu entry in the new interface or via the IMPLEMENT_TRANSFER api.
- There are several improvements to the graphical presentation of results of the PV analysis and QV analysis functions.
- An additional AC Contingency Solution function is provided. This function includes a generation dispatch function to handle unbalances in generation and demand resulting from contingencies. It also includes swingless islands resulting from contingencies in the network solution. It is accessible via the ***Power Flow>Solution>AC contingency solution (ACCC)*** menu entry in the new interface or via the ACCC_WITH_DSP api.
- The contingency ranking function now provides for an overload ranking of single machine outage contingencies. It is accessible via the ***Power Flow>Linear Network> Single contingency ranking (RANK)*** menu entry in the new interface or via the RANK_BRN_AND_MAC api.
- Several PSS®E api's now supply default values for data items which are not specified when the api is referenced. For example, when using the SCAL api from a Python program or via the BAT_SCAL command, defaulting any of SCALVAL entries (1) through (6) results in the corresponding quantity being unchanged during the scaling operation. Refer to *PSS®E Application Program Interface (API)* for details.
- The SCAL api now allows the user to define the scaling targets by specifying incremental powers (e.g., change the load in the specified subsystem by +100.0 MW).
- When the generator bus limit checking report (activity GENS) is reporting a subset of plants (online plants, Var limited plants, or Var limited plants with unequal Var limits), any subsystem being checked which contains at least one plant, but for which no plant meets the reporting criterion, is listed in the report with NONE printed.
- When the controlling transformer limit checking report (activity TLST) is reporting controlling transformer violations, any transformer category in any subsystem being checked which contains at least one such controlling transformer, but for which no violations are detected, is listed in the report with NONE printed.
- The new API XEQV is similar to EEQV but it constructs an equivalent of the portion of the working case outside of the specified subsystem. These functions are accessible

via the Build electrical equivalent tab of the ***Power Flow>Equivalence Networks*** menu entry, or via the XEQV and EEQV apis.

- A function for outputting the network admittance (Y) matrix, as used in the PSS®E power flow solution activities, is added. It is accessible via the ***File>Export>Network admittance matrix*** menu entry in the new interface or via the OUTPUT_Y_MATRIX api.
- Rather than terminating PSS®E, the zero impedance line processing routine sets the zero impedance line threshold tolerance to 0.0 (thereby disabling zero impedance line modeling) if more than 50 buses are connected together by zero impedance lines or if more than 50 zero impedance lines are connected together.
- Commands have been added to activities PSEB and PSAS for changing the status of three-winding transformers such that one winding is out-of-service while the other two windings are in-service.
- The two sets of application-wide parameters previously accessible via the ***Power Flow>Options*** and ***Edit>Preferences*** menu entries have been combined and are now accessible from the ***Edit>Preferences*** menu entry.
- Many functions which require or allow the specification of an auxiliary data input file now include an Edit button next to the file selection field in the dialog. Pressing the ***Edit*** button invokes a text editor (whose pathname is specified in the ***Edit>Preferences*** dialog) loaded with the file whose name is specified in the input field. This allows the input file to be examined or modified without leaving PSS®E, and before the file is passed to the application function.
- There is an option to omit out-of-service equipment when performing a Grow or Auto-Draw operation in the diagram view, and an option to Grow or AutoDraw only those items connected to buses in the current bus subsystem. These options are enabled in the ***Edit>Preferences*** dialog.
- A Bus Location File may be used to specify bus locations on one-line diagrams in Cartesian or GIS coordinates.
- A number of other user suggestions and requests pertaining to the diagram view have been implemented.
- The Input and Output areas of the Command Line Input dialog have been combined so that their use more closely resembles a console window mode of operation. User input is now color coded. A file selector dialog is available from the right-click menu in the input window. Pressing the up arrow or down arrow keys while focus is in the input area of the Command Line Input dialog will move up and down in the command history stack.
- The new Python module caspy allows execution of the Saved Case Data Extraction Subroutines (USRCAS) from a Python program. These subroutines are used to extract data from a PSS®E Saved Case File.
- The PSS®E interface routines for use in IPLAN programs include the following new routine: ITERAT returns the number of iterations used in the last network solution attempt. New STRING values have been added to several PSS®E interface routines: PCTMVA, PCTMVB and PCTMVC in routines BRNMSC and WNDDAT return MVA loadings as a percent of rating sets A, B and C, respectively. The SOLVED routine, as well as the new ITERAT routine, return the status of the most recent conventional power flow or OPF solution attempt.

- In the AcccBrwsGrid, the number of non-converged contingencies is now reported on the Study Summary tab. In addition, a number of new spreadsheet manipulation features have been added.

The following new features are added at PSS®E-30.1.2:

- The number of digits output by the OUTPUT_Y_MATRIX function for the real and imaginary components of each term is increased from 6 to 15.
- Alerts generated from automation files used at program startup are now directed to the progress device, as is done for automation files initiated interactively.
- The maximum number of relays for which relay characteristics can be input via the PSSPLT activity RELY is increased from 200 to 2500.

The following new features are added at PSS®E-30.2:

- The maximum number of FACTS devices allowed is increased from 20 to 40 at 12,000 through 49,000 buses, and from 50 to 99 at 50,000 buses and above.
- Following a power flow solution in which area interchange control is enabled, areas which fail to achieve their desired net interchange are logged.
- The Contingency Description Data File includes provision for a SKIP block structure. Using this structure, the user may designate a set of branches which are to be exempted from outaging as the result of subsequent SINGLE, DOUBLE, BUSDOUBLE, and PARALLEL contingency specification records.
- The following features are implemented in the AC Contingency Reporting functions ACCC_SINGLE_RUN_REPORT and ACCC_MULTIPLE_RUN_REPORT:

  A different rating set may be used in reporting base case results than is used in reporting contingency case results.

  Monitored branches and interfaces whose loadings are in violation in the base case may be excluded from processing in the contingency case loading reports.

  There is provision for a minimum contingency case percent loading increase for processing monitored branches and interfaces in the contingency case loading reports.

  Buses which violate a specified voltage range in the base case may be excluded from the corresponding range check in the contingency case voltage violation reports.

  The title banner of the loading and voltage reports indicate any of these element filtering options which are active.

  The name of the AC Contingency Results File is included in the output of the AC Contingency Run Report function.
- In the API which constructs the Distribution Factor Data File (DFAX), the absence of at least one monitored branch or interface is no longer a fatal error. If presented with a Distribution Factor Data File in which no monitored branches or interfaces are specified, the linear network based calculations (e.g., DCCC, TLTG, etc.) print an error message and terminate.
- A new area totals function (AREA_ZONE) is supplied. It provides subtotals by zone for each area reported. Similarly, a new zone totals function (ZONE_AREA) is included which provides subtotals by area for each zone reported. Each of these functions is accessible by selecting the appropriate check box in the dialog brought up the the ***Power Flow>Reports>Area/owner/zone totals...*** menu entry.
- The case comparison function (DIFF) has additional comparison codes such that generation, line flows, and line losses may be reported based on differences in active power only, reactive power only, or either active or reactive power.

- The tie line case comparison function (DFTI) has additional comparison codes such that line flows and line losses may be reported based on differences in active power only, reactive power only, or either active or reactive power.
- In the scaling function's dialog accessible from the ***Power Flow>Changing>Scale generation, load, shunt (SCAL)...*** menu entry, scaling targets may now be defined by specifying incremental powers.
- In the three-winding transformer reports of LIST and EXAM, winding impedances are now reported in per unit on system base MVA regardless of the value of CZ.
- Where it tabulates positive sequence equivalent admittances, the multiple unbalanced fault analysis calculation (SCMU) outputs admittances in both per unit and MVA.
- Many additional PSS®E api's now supply default values for data items which are not specified when the api is referenced. Refer to *PSS®E Application Program Interface (API)* for details.
- Spreadsheet customizations such as column moves/hides/freezes are preserved between executions of PSS®E.
- A Locate bus feature is added to the General toolbar and to the popup menu on the Diagram view. Selecting Locate bus locates the selected bus on the Diagram view if it exists.
- Toolbar icons are now available for managing views and layers in a diagram. By default, they are created in the Diagram Options toolbar which can be displayed by selecting the ***Tools>Customize...*** menu entry and then selecting Diagram Options.
- The termination state of the last power flow solution attempt (e.g., met convergence tolerance, blown up, etc.) is displayed in the status bar at the bottom of the PSS®E window.
- Positional information for non-transformer branches and two-winding transformers for use in Grow and Auto-Draw operations may be specified in the Bus Location File.
- Power Flow Raw Data Files in any of the formats required by PSS®E-15 or later may be read into PSS®E. From the ***File>Open...*** dialog, select ***Power Flow Raw Data File, Previous versions (*.raw)*** from the ***Files of type*** list.
- Power Flow Raw Data Files in any of the formats required by PSS®E-15 or later may be written by PSS®E. From the ***File>Save or Show...*** dialog, select the ***Power Flow Raw Data File, Previous Versions*** tab.
- The CONVERTRAW auxiliary program reads a PSS®E-15 or later Power Flow Raw Data File and outputs data in any later Power Flow Raw Data File format.
- The CREATERAW auxiliary program reads a PSS®E Saved Case File and outputs data in the form of a PSS®E-15 Power Flow Raw Data File.

The following new features are added at PSS®E-30.2.1:

- Eliminated minor inconsistencies in the application of the bus boundary condition contingency events (SET, CHANGE, INCREASE, DECREASE and MOVE contingency records) in ac contingency analysis, PV analysis, and QV analysis.
- The following fetch routines, available from Python and IPLAN, recognize string values for which they return the number of CON, STATE, VAR and ICON array entries used by the specified model instance: MDLIND, LMODIND, SLMODIND and RMODIND.

The following new features are added at PSS®E-30.3:

- More flexibility in the convergence testing applied to the Newton-Raphson based power flow solutions is available through the use of a pair of new solution parameters which are used in evaluating convergence.
- An ac corrective actions function which relieves loading and voltage limit violations in the working case is provided. It is formulated an an optimal power flow problem with the objective of minimizing load curtailment, active power generation redispatch, and phase shift angle adjustment. It is accessible from the ***Power Flow>Solution>AC corrective actions...*** menu entry or via the ACCORAPI API,
- A dc corrective actions function which relieves loading violations in the working case is provided. It is formulated as an optimal power flow problem which is solved with a linear programming method. Adjustments to loads, phase shift angles, and generator active powers are applied to eliminate loading violations. It is accessible from the ***Power Flow>Linear Network>DC corrective actions...*** menu entry or via the DCCORAPI API,
- In the multiple level ac contingency solution function, an ac corrective actions solution may be performed to relieve loading and voltage limit violations in post-contingency solutions. It is accessible from the ***Power Flow>Solution>Multi-Level AC contingency solution...*** menu entry or via the MACCC_WITH_COR API,
- Solution options used by the various ac contingency analysis functions are saved in the AC Contingency Solution Output Files, and reported by the ac contingency reporting functions.
- The ac contingency single run report function has an additional report option used to report tripping simulation solutions performed in the multiple level ac contingency analysis function. Post-tripping solutions are treated as contingencies and reported in all report formats with the selection of the Report post-tripping simulation solutions option.
- In the dc analogy power flow API (DCLF), the active power flowing into dc lines and series FACTS devices is no longer netted with the load for reporting purposes. These are now reported in the branch flow block of the buses to which they are connected, and the reported load is the net active power load and bus shunt. (The modeling of dc lines and FACTS devices in the linear network analysis calculations is unchanged.)
- In the APIs which calculate interchange limits using a linear network model (TLTG, SPIL and POLY), flows on dc lines and series FACTS devices which are study system ties are included in study system interchange totals reported. Further, in TLTG and SPIL when total (rather than incremental) transfer limits are reported, these flows are also included in the reported transfer limits.
- The following are new contingency event records which may be specified in the Contingency Description Data File:
  BLOCK TWOTERMDC i
  BLOCK MULTITERMDC i
  BLOCK VSCDC label
  BLOCK FACTS i
- Added the ability to create simple Subsystem Description, Monitored Element, and Contingency Description Data Files from the GUI using the current subsystem definition as a basis for the selection of elements. This function is accessible from the ***Power Flow>Linear Network>Create/modify SUB, MON and CON configuration files...*** menu entry.

- In picking up pre-PSS®E-27 Saved Cases, zero sequence transformer line shunt data is converted to the PSS®E-30 transformer model wherever possible.
- PSS®E-30.3 is compatible with Siemens PTI's new Graphical Model Builder (GMB) Module for PSS®E. This licensable module provides the ability to build and maintain AVR and Governor models using an intuitive Microsoft® Visio-based interface.
- The diagram management tool, Slider, includes a powerful new Contour Plotting capability. Users can contour PSS®E results via an easy-to-use Contour Management window.
- The Busbar Fill property is now saved and restored with each individual Diagram rather than on a system wide basis.
- It is now possible to toggle all the bus symbols in a Diagram without having to individually select each bus. This functionality is found on the Toggle Bus icon on the Diagram Options toolbar. This toolbar is turned off by default. It can be turned on through the ***Tools>Customize...*** menu entry.
- A new Python module "pssarrays" is supplied. It provides APIs as Python functions to retrieve PSS®E solution results in arrays. These arrays then can be used in a Python script to post-process or create customized reports, export them to text file or Excel spread sheet, and so on. At this release following functions are available in this module:

  accc_summary: returns ACCC monitored element labels, contingency labels, etc.

  accc_solution: returns ACCC post-contingency, post-tripping or post-corrective action solution monitored MVA flows, ampere flows and bus voltages for one contingency.

  accc_summary_report: generates text report of arrays returned by "accc_summary"

  accc_solution_report: generates text report of arrays returned by "accc_solution"

  accc_violations_report: generates text report of monitored flow and bus voltage violations of ACCC post-contingency, post-tripping or post-corrective action solution
- A new example file "accc_reports.py" is supplied. It shows the usage of ACCC arrays fetch APIs in "pssarrays" module to generate custom accc solution reports.

The following new features are added at PSS®E-30.3.1:

- The results of ac corrective actions are applied to the working case rather than just reported. The results of dc corrective actions may optionally be applied to the working case rather than just reported.

Optimal Power Flow

The following new features have been introduced into the PSS®E OPF module at release 30.1:

- The SOLVED interface routine, for use in IPLAN or Python programs, has been expanded to report on the results of an optimal power flow solution. Valid return values include: (1) Problem seems infeasible, (2) Maximum number of iterations exceeded, (7) Optimal solution found or (9) Solution not attempted.
- The new ITERAT interface routine, for use in IPLAN or Python programs, will return the number of iterations taken after an OPF solution attempt.

The following new features were introduced into the OPF module at release 30 of PSS®E:

- PSS®E OPF data records can now be purged through the OPF Spreadsheet View and OPF Data Table Editor.
- BAT_ purge commands, Python calls and programming API's have been introduced for each PSS®E OPF data record. Refer to Chapter 3 of the *PSS®E API* manual.
- The maximum number of allowable active power dispatch units represented in a PSS®E OPF working case has been increased to 2000.
- The maximum number of allowable branch flow constraints represented in a PSS®E OPF working case has been increased to 6000.
- Six digit bus numbers (through 999997) and extended bus names are fully recognized.
- Output and solution report formats have been modified to accommodate six digit bus numbers and extended bus names, and to improve readability.
- Voltage source converters (VSCs) are recognized and treated as equivalent load injections.
- The RMPCT values of switched shunts, FACTs devices and VSCs are recognized and processed by the PSS®E OPF.
- Switched shunt MODSW values of 3, 4 and 5 are recognized and handled in the following manner:

  In-service and optimized (not fixed) switched shunts with a MODSW of 3 or 5 introduce further restrictions on the reactive generation or admittance limits of regulated generators or switched shunts (local or remote) during the OPF solution. For switched shunts that are not optimized (fixed) no adjustments are made to the limits. A switched shunt with a MODSW of 4 (controlling reactive power of VSCs) is introduced as a normal OPF switched shunt control. Since VSCs are handled by the OPF as equivalent load injections, no adjustments are made to the VSC limits.

1.11.8 Program Corrections

The following program errors have been detected and corrected in PSS®E-30.0:

- Activity JOIN could sometimes fail when the bus being removed was connected to two or more three-winding transformers.
- Activity SCMU produced incorrect results for the one end opened unbalance when the pu distance from the closed end was set to 1.0 (i.e., a line end fault).
- Following an OPF solution, the controlled side indication (i.e., the sign of CONT) for a voltage controlling transformer was always set positive.
- Activity RANG of PSSPLT did not recalculate scale values if a new Channel Output File was read in using activity CHNF or MCHN.

The following program errors have been detected and corrected in PSS®E-30.0.1:

- If the name of the new bus in the line tapping api (activity LTAP) was specified in lower case, it was not converted to upper case before the bus was added to the working case.
- The new OPEN and CLOSE commands for THREEWINDING transformers in activity PSEB generated incorrect activity CHNG dialog.
- When a QV analysis calculation was performed with tap ratio and/or phase shift angle adjustment enabled, results for contingency cases could have been incorrect. The error occurred when tap or phase shift adjustment was required in the solution of the base case at the specified initial (maximum) study bus voltage (VHI).
- When a PV analysis calculation was performed with tap ratio and/or phase shift angle adjustment enabled and with the ECDI dispatch method specified for the source and/or sink system, results for contingency cases could have been incorrect. The error occurred when tap or phase shift adjustment was required in the solution of the base case following the ECDI redispatch of the appropriate system(s).
- Phase shifter flow limits were incorrectly set after an OPF solution.
- If a member of the CLODxx model family was connected to an out-of-service load, it could corrupt VAR array values assigned to another model.
- When a Python program was executed with recording turned on, api references which involved multiple filename specifications could have had incomplete names recorded for some of the files. Api’s affected included ACCC, APPEND_ACCC, ASCC, BKDY, BSNM, DFAX, MWMI, POLY, PSEB, PV_ENGINE, QV_ENGINE, RANK, RNFI, SCEQ, SPIL, TLTG, OPTO, DYRE_ADD, DYRE_NEW, PSAS and SRRS.
- When a PSS®E-30 Saved Case containing three-winding transformers was specified to RAW23 or RAW26, the star point buses were assigned bus numbers beyond the 99997 bus number limit that existed prior to PSS®E-30. In the resulting bus data records, these bus numbers were printed as *****.
- Conversion programs RAW23, RAW26, RAW28, RAW29, RAWECC, and any programs written using the PSSMDC subroutine of the Saved Case Data Extraction Subroutines (USRCAS), could have generated incorrect dc bus names when processing a PSS®E-29 or earlier Saved Case File containing more than one multi-terminal dc line.
- Conversion program RAWECC had not been modified to handle the increase in names from 8 to 12 characters for buses, areas, zones, etc.

- Several errors in the new interface have been detected and corrected.
- Several errors in the Line Mode Interface (LMI) have been detected and corrected.

The following program errors have been detected and corrected in PSS®E-30.0.2:

- A BAT_ command for which there were multiple values for a single argument (e.g., an array of options) that spanned multiple lines could generate an error during deallocation for extra variable character.
- The SCAL api could leave arrays allocated when called with APIOPT = 0 if an error was detected in the APIOPT 2 phase of its processing.
- When executing activity ASCC with ECHOing turned on, the output field was not wide enough if output for buses more than nine levels back is specified.
- Activity DFAX or an application function using a Distribution Factor Data File could have crashed if any DISCONNECT BUS contingency event specified in the Contingency Description Data File resulted in the outaging of a three-winding transformer connected to the specified bus.
- The PV analysis calculation could have behaved incorrectly when the ECDI dispatch method was used for establishing the transfer in the sink subsystem, and the number of buses participating in the transfer in the sink subsystem was greater than the number of participating buses in the source subsystem.
- The PV analysis calculation could crash or exhibit some other unexpected behavior when transfer dispatch method 2 or 3 was used for the study (source) system, and a participating load was driven to a negative value.
- The OPF Parameters dialog could crash when ***OK*** is clicked.
- The OPF solution could crash if a switched shunt and generation existed at the same bus, and the generation was driven to a reactive power limit.
- In the excitation system models REXSYS and REXSY1, the factor F (associated with limits on STATEs K+3 and K+9) is now limited to 1.0 to keep it consistent with current WECC modeling practice.
- In the TIOCR1 model, the test for monitor only or monitor and trip was reversed.
- The PTOTxx models were not handling wind generators correctly.
- In the PTOTxx models, the summation of generator electrical power was lagged by one time step.
- In the Line Mode Interpreter (LMI) and in processing Response Files in the new interface, ranges of areas, zones and owners in specifying subsystems (e.g., 1,-10) were not handled correctly.
- In calling SEQD from Python, psspy.seqd required three items for the OPTIONS array (the third was not used) rather than the two items that the SEQD api actually requires.
- In calling TLTG from Python, psspy.tltg required five arguments rather than the four that the TLTG api actually requires.
- The api's polycmndprint, pvcmndprint, and qvcmndprint were not recognized in Python programs.
- Switching the status of a three-winding transformer from the Diagram View did not work correctly.

- Changing the Winding Code of a two-winding transformer to Turns ratio (pu) from the Spreadsheet View resulted in incorrect winding 1 and 2 tap ratios.
- IPLAN programs that directed output to the report window would sometimes find the first line of output directed to the progress window. Deleting the report window and re-running the IPLAN program would result in a program crash.
- The file selector presented by using FILESEL in IPLAN programs showed the mask argument incorrectly in the filename field.
- The parsing routines (named GTxxxx) in IPLAN had returned incorrect values for several releases.

The following program errors have been detected and corrected in PSS®E-30.1:

- When MVAR controlling transformers were adjusted during Newton solutions, if the adjustment calculation detected a singular matrix at a row corresponding to a MVAR controlling transformer tap, PSS®E could crash while attempting to print the error message.
- Activity SPLT could have crashed if there were multiple three-winding transformers connected to the bus being split, and more than one of these was to be connected to the new bus.
- In the AC Contingency Solution, PV Analysis, and QV Analysis, following the processing of a contingency case containing a status change contingency event imposed on a three-winding transformer, the status of the three-winding transformer was not restored to its original value.
- The AC Contingency Solution, PV Analysis, and QV Analysis functions could have crashed if all of the following conditions were met: a three-winding transformer contingency was imposed; a Load Throwover File had been specified; and the bus to which winding 1 or winding 2 of the outaged three-winding transformer is connected was specified as a bus which could have its load transferred to another bus.
- In the AC Contingency Solution, PV Analysis, and QV Analysis, the original winding 1 tap ratio array could have failed to get restored to its original value if all of the following conditions were met: ac tap adjustment was disabled; dc tap adjustment was enabled; and an ac transformer which was controlling a two-terminal dc line quantity had its winding 1 tap ratio adjusted during a network solution.
- In the AC Contingency Solution, PV Calculation, and QV Calculation, when a contingency case contains an ADD contingency event (i.e., placing a machine in-service) and the bus type code is 1, the bus type code is changed to 2 and the machine placed in-service. Previously, the machine was left out-of-service, no warning was printed, and the contingency was calculated with that event omitted.
- In the AC Contingency Report function, branches whose contingency case loadings differed from their base case loadings by less than the Minimum contingency case flow change for overload report data item could incorrectly be included in the spreadsheet overload report.
- In the ***Power Flow>Changing>Economic dispatch (ECDI)*** menu entry of the new interface, if the ***Cancel*** button was pressed in the Dispatch Parameters dialog, unexpected results could sometimes have occurred. The Cancel button has been removed from the Dispatch Parameters dialog.

- Activities ASCC and SCGR produced incorrect results when the following conditions were all met: the ***Flat conditions*** option was selected; transformer impedance correction tables were present in the case and assigned to one or more transformers; and the actual impedance of at least one transformer differed from its nominal impedance due to the multiplier from its impedance correction table.
- The owner renumbering api (OWNR) could have reassigned ownership attributes for branches, FACTS devices, and/or VSC dc lines which were outside of the specified subsystem and which should have been excluded from having their ownership changed.
- When called either via their BAT_ commands or from a Python program, the following api's inadvertently allowed blanks to be specified as circuit, machine and load identifiers: MBIDBRN, MBIDMAC, MOVE3WND, MOVEBRN, MOVELOAD and MOVEMAC.
- In the PV Analysis and QV Analysis dialogs, the initial values of the solution adjustment options were not set correctly.
- LSYSAN could crash in EIGP and PLEI while printing eigenvectors.
- When working on any tab of the Spreadsheet View, column sorting would be lost after a solution or network modification was performed.
- Several errors in the new interface have been detected and corrected.

The following program errors have been detected and corrected in PSS®E-30.1.1:

- The PSS®E-30.1 patch would not install if the .ini files in your Windows folder (e.g., c:\Windows) had paths that pointed to the R: drive.
- The selection of a bus subsystem failed in the area, bus, owner and zone spreadsheet tabs. The subsystem was set correctly, but the selected buses were not displayed in the spreadsheet.
- Incorrect data was displayed in the LMI activity CHNG (prompts affected in the transformer, two-terminal dc line, solution parameter, and branch ownership data categories).

The following program errors have been detected and corrected in PSS®E-30.1.2:

- The modified Gauss-Seidel power flow solution function (MSLV) could have crashed if multiple FACTS devices were present at the same bus (or at buses connected together by zero impedance lines), at least one of which had no series element, and at least one of which had a series element.
- In the sequence data input functions RESQ and TRSQ, the three two-winding transformer connection codes, corresponding to a specified three-winding transformer connection code, were not set correctly.
- The auxiliary data input file renumbering function, RNFI, failed to renumber buses that were associated with some dynamic models.
- Results of the Drop Unit disturbance in dynamics were not correct.
- The Command Line Input dialog could stop accepting input.
- The reactive power values shown in diagrams for three-winding transformers ignored the precision setting.
- Operations involving the spreadsheet could experience large delays in responsiveness. A Sort Rows message is displayed on the left side of the Status Bar.

- In the AcccBrwsGrid, numeric columns which included numbers in scientific notation could be sorted incorrectly.

The following program errors have been detected and corrected in PSS®E-30.2:

- When adding/modifying three-winding transformer data via a Power Flow Raw Data File, transformers connecting the same three buses and with the same circuit identifier could get added to the case rather than replacing the three-winding transformer already there.
- When CM was 2, an incorrect conversion of the magnetizing admittance of three-winding transformers from input units to the per unit value stored internally could have occurred when the winding 1 nonimal voltage differed from the winding 1 base voltage. This occurred during Power Flow Raw Data File input as well as in changing the nominal voltage field on the windings tab of the three-winding transformer spreadsheet.
- Three-winding transformer impedance could have been changed from their input values when CZ was 3 following use of the THREE_WND_WINDING_DATA api. This occurred when the derived reactance of one of the windings was negative.
- Operation of the bus joining function JOIN could result in duplicate circuit identifiers for parallel three-winding transformers when one or more three-winding transformers were originally connected to both the retained bus and the deleted bus.
- In applying the fault slider in SCMU, incorrect results could have been calculated if the branch being subjected to the unbalance was involved in any zero sequence mutual couplings.
- The OPF solution could crash if there was an optimized bus with a bus type code of 2 (generator bus) which had no machines connected to it.
- The OPF solution crashed if one or more FACTS devices were present in the network.
- On the three-winding transformer tab of the spreadsheet, sorting the three-winding transformers resulted in incorrect winding information being displayed.
- Identifiers were not being updated in open diagrams, even if the option was selected in ***Edit>Preferences***.
- The GUI dialog for setting up IEC909 fault calculations did not allow a generator power factor of 0.0 to be specified.
- The GUI could sometimes append random characters to the name of the new bus when splitting a bus.
- When multiple sets of QV curves were plotted, the second and subsequent sets used the data points of the first set.
- QV automated ploting plotted the same curves even if different results files were loaded.
- The defined Text Editor sometimes had problems opening files if the full path contained blank characters.
- Several corrections were made in the Line Mode Interface (LMI):

  The Newton-Raphson solution activities incorrectly handled omitted values when the OPT suffix was specified.

  Activity ACCC no longer requires that the ACCC Solution Output File already exist prior to executing.

Activity INLF no longer requires an Inertia/Governor Response Data File.

Activity DSCN no longer presents a spurious output device dialog.

Activity DIFF now correctly handles the load characteristic data category and allows the line ratings difference check.

Several corrections were made to the order of prompts presented for activities ARNM, ZONM, BSNM, CHNG, DSCN and DIFF.

- The Python command to purge an OPF active power dispatch table (purge_opf_apdsp_tbl) did not work.
- The Python commands to retrieve switched shunt block data (swsblk and swsblz) did not return correct values.

The following program errors have been detected and corrected in PSS®E-30.2.1:

- PSS®E could crash when adding a new three-winding transformer to the working case under the following conditions: (1) CM was specified as 2; and (2) MAG1 was too big relative to MAG2 and the specified winding base MVA.
- The array of remotely controlled buses for VSC dc line converters was not updated by the bus joining function, JOIN.
- In dynamics, changing the status of a zero impedance line from the Trip Branch and Close Branch Disturbance menu entries (or their corresponding APIs, DIST_BRANCH_TRIPAPI and DIST_BRANCH_CLOSEAPI) did not update the zero impedance line bus connection tables, resulting in incorrect results.
- In specifying output channels by subsystem (CHSB), bus voltage, angle and frequency channels for the star point buses of three-winding transformers were generated when the entire working case was selected for processing.
- In the Switched Shunt Model SWSHN1, the switch timer used for the turn ON and turn OFF of capacitor banks was not correct.
- PSS®E results of using the Turbine Load Controller model ULCFB1 would be incorrect if the power controller flag, pcf, was not set to 1.
- Error corrected in LMI activity CHNG in the handling of data affected by transformer IO codes if those codes were changed.
- There were certain conditions under which PSS®E could crash upon closing the program.
- PSS®E could crash when comparing powerflow cases if the dialog used to select the items to be compared is moved on the screen.
- Unable to set the connection code to 8 for two-winding transformers in the GUI spreadsheet.
- The EXEC activity in the GUI now recognizes arguments
- Line overloads are not always correctly identified in Diagrams.
- The Loading basis for % Rating was not always displayed correctly in Diagrams for transformers.
- Kneepoints on lines drawn using a Bus Location file can be wrong.
- Summation labels can yield incorrect results and generate Progress window error messages when opening Diagrams.

- IPLAN's fileset was corrected to filter the file list using the filemask field.
- Errors have been corrected in the Python extension module (psspy) that affected Power Flow option setting routines as well as TIME, JOIN, NXTBRN, and NXTBRN3.

The following program errors have been detected and corrected in PSS®E-30.3:

- In changing data for a two-winding transformer, a bad value for the transformer status resulted when both of the following conditions were met: (1) the buses connected to winding 1 and winding 2 of the transformer were being interchanged; and (2) two-terminal dc lines were present in the case.
- When changing branch ownership for three-winding transformers in a subsystem using the OWNM API, an incorrect classification of three-winding transformers as either internal subsystem branches or tie branches could have occurred, thus causing them to be incorrectly included or omitted from the ownership reassignment processing.
- When a switched shunt was controlling the reactive output of a VSC dc line converter (MODSW = 4), and the VSC dc line was subsequently removed from the case, switched shunts controlling VSC dc line converters may have then pointed to an incorrect VSC dc line.
- The Gauss-Seidel power flow solutions (SOLV and MSLV) can crash when they are executed with switched shunt adjustment enabled.
- The inertial and governor response load flows (INLF) implement the dispatch of the change in island swing bus active power incorrectly if a dc converter is connected to the island swing bus.
- In the AC Contingency Analysis Multiple Run Report function: if the master contingency legend report was printed, the loading violations reports were omitted, and any of the voltage violations reports were printed, then the voltage violation reports were incorrect.
- In the AC Contingency Analysis Multiple Run Report function, generating the all contingency case loading violations and all contingency case voltage violations reports was very slow.
- In the worst case contingency case loading violations and worst case contingency case voltage violations reports of the AC Contingency Analysis Multiple Run Report function, when results for the same element are identical to report format tolerance for multiple contingencies in multiple runs, they might not have been assigned to the first of such contingencies.
- The PURGE_MULTI_TERM_DC_BUS API incorrectly deleted the dc bus with the largest number in the selected multi-terminal dc line if a dc bus number greater than that of the dc bus with the largest number was specified.
- In the dc load flow solution function, when a three-winding transformer status change was selected for the contingency case and DCLF was to be terminated with the contingent branch in its original status, the original status might not have been restored correctly.
- The PRE-SHIFT MW column of the summary output of SPIL could have had incorrect values.
- The ANSI fault calculation could crash if a bus specified to be faulted was a type 4 bus.

- Load model CIM5AL and load relay models LDSHAL, DLSHAL, LDSTAL, LVSHAL, LDS3AL and LVS3AL contained in pre-PSS®E-30 dynamic snapshots were not retrieved correctly in PSS®E-30.
- The DYRE API did not recognize the load characteristic models CIM6OW, CIM6ZN, CIM6AR and CIM6AL.
- The aBrn... and aTrn... subsystem data retrieval APIs could have returned incorrect results when ENTARG was specified as 1 and the bus numbers program output option setting was in effect.
- When changing the Winding I/O code for a two-winding transformer and moving off the record, the winding ratio is calculated incorrectly.
- When selecting a three-winding transformer and a specific winding from the spreadsheet, if the three-winding transformer is deleted from the network through the Diagram, the program will crash when returning to the spreadsheet. A similiar crash could occur for two-terminal, multi-terminal, and VSC dc lines.
- When two GOUT Diagrams are open, both of which contain multi-section line elements, toggling the multi-section line reporting option can cause a crash.
- When displaying a difference diagram, VSC dc lines could have been annotated incorrectly if: (1) there were multiple VSC dc lines in at least one of the cases being compared; and (2) the internal numbers of matching VSC dc lines were different in the two cases.
- Under certain conditions, activities RANG and SCAN in PSSPLT would process data for the entire simulation rather than the time interval specified to TINT.
- Outputing the working case in the form of a PSS®E-29 Power Flow Raw Data File produced incorrect output when zone names and owner names are not specified.

The following program errors have been detected and corrected in PSS®E-30.3.1:

- When switched shunt adjustment was enabled in PV and QV analysis, those switched shunts whose control mode was 1 (discrete adjustment controlling voltage) and which controlled to a setpoint (VSWHI = VSWLO) were adjusted only in the first power flow solution attempt of the base case and locked for all other power flow solutions.
- In the aLodBusReal, aLodBusCplx, aLodReal, and aLodCplx APIs for returning load related data for a subsystem, if both nominal and actual data were requested in the same call, the type (actual or nominal) of the last such data item requested was applied to all such data items requested.
- Custom toolbar definitions that referenced RESPONSE or IPLAN files did not work due to file path issues.
- Recording certain APIs associated with Slider Diagrams would result in error messages.
- In the old interface, changing the bus input mode to names and then using the data editors could result in a program crash.
- The Case Data Extraction Routines (USRCAS) were unable to read Saved Case Files from revisions 30, 30.1 and 30.2. This prevented the ability to create earlier versions of Power Flow Raw Data Files from these cases.
- ConvertRaw produced some spurious empty Message boxes.

- There are a few routines in Chapter 2 of the *PSS®E Application Program Interface (API)* manual that define arguments as single element arrays. Releases 30.0.0 through 30.2.1 required scalars for these arguments when using Python. Release 30.3.0 required a list, even though the recorder produced a call representing the value as a scalar. Release 30.3.1 allows either.
- INI files were not being found for IMD, PSSPLT, and the old dynamics interface.

The following program errors have been detected and corrected in PSS®E-30.3.2:

- In the tripping simulation, tripping actions to change load, generation and shunt that are specified by SET, INCREASE, DECREASE or MOVE are skipped.
- The PV_ENGINE_2 API could have crashed if switched shunt adjustments were enabled in base case transfer increment solutions but not in contingency case solutions.
- In dynamics, model edits (MODE=8) for user models resulted in a crash.
- In the new interface, splitting a bus through the Diagram would not move the switched shunt symbol to the new bus, even if that action was specified.
- Numerous errors were fixed in the Line Mode Interpreter, most notably for SCMU,SI, PURG, and the switched shunt existence check.
- Fixed error in recording ac contingency post-processing calls.
- Resolved startup issue with INI files.
- Dynamics initialization fix to support the Graphical Model Builder (GMB).

The following program errors have been detected and corrected in PSS®E-30.3.3:

- When multiple MOVE LOAD contingency events were specified for the same bus in the same contingency (e.g., to move 20% of bus 1 load to bus 2, and 20% of bus 1 load to bus 3), an incorrect amount of load was processed by the second and subsequent MOVE LOAD commands.
- DCCC, TLTG, SPIL and POLY could have crashed when both of the following conditions were satisfied: (1) the convert MVA ratings to estimated MW ratings option was enabled; and (2) a monitored branch had its reactive power loading in the working case greater than or equal to its rating.
- The phase shifter adjustments from corrective actions in the multiple level contingency analysis are reported incorrectly: the wrong phase shifters are reported in the control adjustment sections of corrective actions reports.
- The presence of three-winding transformer ties from the subsystem to be equivalenced, could have resulted in a zero divide by the equivalencing function EEQV. Similarly, if either of the options to retain area and zone boundary buses were enabled, the presence of three-winding transformer area and zone ties in the subsystem to be equivalenced, could have resulted in a zero divide by EEQV.
- In the equivalencing function EEQV, if the option to retain two-winding transformers which have a non-zero phase shift angle was enabled, an incorrect equivalent could have resulted if any three-winding transformers which have a non-zero phase shift were equivalenced.

- When EEQV terminated abnormally, the working case, which should have been unchanged, had incorrect type codes at boundary buses when equivalencing by subsystem had been specified.
- If the network connectivity checking functions (TREE, ISLAND, and the corresponding function in RUN and MRUN) outaged one or all three windings of a three-winding transformer, the three-winding transformer status was not updated.

1.12 PSS®E-29

1.12.1 General

With the exception of the Power Flow Raw Data File format, there is complete compatibility between PSS®E-28 and PSS®E-29 at the data input file level. That is, any other binary or source data file which could be successfully accessed by PSS®E-28 should also be able to be read by PSS®E-29.

Dynamic simulation Snapshot Files from PSS®E-20 through PSS®E-28 can be read by PSS®E-29.

A dynamics setup used in PSS®E-28 or PSS®E-27 is able to be used in PSS®E-29 without change. The connection routines (CONEC, CONET, USRXXX, USRLOD and USRREL) and user-written models used in PSS®E-28 or PSS®E-27 need only be recompiled.

The connection routines and user-written models used in PSS®E-26 require the addition of the USRREL routine (see Dynamic Simulation of the PSS®E-27 update notes below); the connection routines and user-written models used in PSS®E-25 also require the addition of the USRLOD routine (see Dynamic Simulation of the PSS®E-26 update notes below); those used in PSS®E-20 through PSS®E-24 may require additional minor modifications (see CONEC, CONET, and User Models of the PSS®E-25 update notes below). To access simulation setups from PSS®E-19 or earlier, see the PSS®E-20 update notes below. While a mid-run Snapshot File written by PSS®E-22 or earlier may be accessed with activity RSTR of PSS®E-28, it may not be used for the purpose of continuing the interrupted run; the entire simulation must be executed.

The majority of PSS®E-29 activities and functions are identical in dialog to PSS®E-28. Dialog changes that have occurred as a result of new program features are described below (see New Features). Any Response Files and IPLAN programs used with PSS®E-28 that contain any of these line mode dialog streams and/or BAT_ commands need to be modified before they can be used in PSS®E-29.

- In activities READ, RDCH and TREA, the Switched Shunt Data record format has been changed, and a new data category for Voltage Source Converter (VSC) DC Transmission Line Data has been added. Refer to Power Flow Raw Data File.
- The BAT_SWITCHED_SHUNT_DATA command has an additional item, the VSC dc line name, added to the end of the command. Refer to Power Flow Raw Data File.
- In the BAT_FACTS_DATA command, the dimension of the INTGAR array is increased from 4 to 5 in order to accommodate the series voltage reference code (see PSS®E *Program Operation Manual*, FACTS Device Data).
- In the BAT_SOLUTION_PARAMETERS command, the dimension of the REALAR array is increased from 14 to 16 in order to accommodate new solution parameters used by the Newton-Raphson based power flow solution activities (see *Program Operation Manual*, Section 6.5.1, Characteristics of Activity FNSL and Section 6.5.3, Non-Divergent Solution Option).

- In the BAT_ACCC, BAT_FDNS, and BAT_FNSL commands, the dimension of the OPTIONS array is increased by 1 to 7, 8, and 8, respectively, in order to accommodate the non-divergent solution flag (see *PSS®E Program Operation Manual*, Section 6.5.3, Non-Divergent Solution Option).
- In the BAT_RAWD command, the dimension of the OPTIONS array is increased from 5 to 6 to accommodate a new option in outputting the Power Flow Raw Data File (see *PSS®E Program Operation Manual*, Section 5.49, Creating a Power Flow Raw Data File).
- Activity OWNM has been extended to allow the changing of the ownership assignment of FACTS devices and VSC dc lines. In its line mode dialog, the fourth prompt is replaced by four new prompts. Similarly, in the BAT_OWNM command, the dimension of the STATUS array is increased from 4 to 7, and STATUS(4) has a new meaning and set of valid values.
- In the BAT_SCOP command, an additional integer data item, APIOPT, is required, and multiple occurrences of the BAT_SCOP command with different values of APIOPT are required for each previous BAT_SCOP command.

IPLAN programs using the IPLAN subroutine SOLVED may need to be modified. The subroutine SOLVED returns additional possible values in its integer argument, N. A value of N equal to zero still indicates that convergence had been achieved in the most recent power flow solution attempt; a positive value of N indicates that convergence was not achieved, and its numeric value indicates the reason for the solution's termination.

1.12.2 Power Flow Raw Data File

The following are the changes to the Power Flow Raw Data File format:

- A new data category for Voltage Source Converter (VSC) DC Transmission Line Data has been added to the Power Flow Raw Data File. VSC dc line data records are expected between the two-terminal dc line data records and the switched shunt data records.
- The Switched Shunt Data record contains an additional data item. An RMIDNT field is inserted between the SWREM and BINIT fields.
- The FACTS Device Data record contains an additional data item. A VSREF field is appended to the end of the data record.

A format conversion program, CNV29 (see *Additional Resources for PSS®E*), is supplied with PSS®E-29. It converts Power Flow Raw Data Files from the format required in PSS®E-27 and PSS®E-28 to that required in PSS®E-29.

1.12.3 Simulation Model Library

The following models are added to the simulation model library:

- ESURRY is a modified IEEE type AC1A excitation system model.
- CELIN is a brushless excitation system model.

The remaining plant-related models supplied in the PSS®E model library which were specified to activity DYRE on USRMDL data records in the Dynamics Data Input File are now supplied in table-ized model form as well as in the form of a user-written model. The new versions of these models do not require calls in the USRXXX subroutine; rather, they are called from internal tables in the same manner that the other table-ized plant-related models are called. The following table summarizes the old and new versions of these models:

Old Model	New Model
CBES	CBEST
CSMES	CSMEST
CSTATC	CSTATT
BEPSS	BEPSST
OSTAB2	OSTB2T
OSTAB5	OSTB2T
URST5B	URST5T
BUDCEZ	BUDCZT
EMAC1	EMAC1T
OEX12	OEX12T
OEX3	OEX3T
URHIDA	URHIDT
TURCEZ	TURCZT
TWDMO1	TWDM1T
TWDMO2	TWDM2T
URCSCC	URCSCT
URGAS3	URGS3T

In all cases, there is a one-to-one correspondence between the CON data list for the old model and the new model to which it is converted. In some cases, the ICON list between the old model and the new model to which it is converted, is modified. The old model set for CSMES, CSTATC, TWDMO1 and TWDMO2 contained ICON space for PSS®E internal memory. In the tablized model, this has been removed from the ICON data list. Hence, while using the corresponding new models CSMEST, CSTATT, TWDM1T and TWDM2T, the user need not input ICON data for memory.

Each Dynamics Data Input File model data record referencing one of the old user-written models is converted internally by activity DYRE to the corresponding new table-driven model. Activity DYRE notifies the user of each conversion that takes place.

At PSS®E-29, two options for handling dynamic simulation setups from PSS®E-28 which include calls in subroutine USRXXX to any of the old plant-related models listed above are available:

3. The old setup may be used. The approach given in General should be followed.

4. Proceed as if the old setup is to be used as above. Pick up the old Snapshot File and use activity DYDA to produce a Dynamics Data Input File, which will include data records for the models. Use activity DYRE to read the Dynamics Data Input File. As described above, activity DYRE converts the old model data records to models from the new set. Dynamics memory should then be preserved with activity SNAP, the new CONEC and CONET files recompiled, any user-written models used in the simulation recompiled, and PSS®E relinked.

PTI recommends that the second procedure, or an equivalent variant thereof, eventually be employed. The old models are considered obsolete and will be removed from PSS®E at a future program release.

1.12.4 New Features

The following new features are added at PSS®E-29.0:

- Provision for the modeling of voltage source converter (VSC) dc lines has been added. A new category called USRVSC has been introduced for user-written models of VSC dc lines. Model subroutine calls for user-written models of VSC dc line will be placed in CONEC and CONET. See *PSS®E Program Operation Manual*, Voltage Source Converter (VSC) DC Transmission Line Data, VSC dc Lines, and Solving the Converted Case.
- Switched shunts may be used to control the reactive power output of generating plants and VSC dc line converters. See *PSS®E Program Operation Manual*, Voltage Source Converter (VSC) DC Transmission Line Data and Switched Shunt Adjustment.
- The FACTS device power flow model has been extended to provide for constant series voltage operation (MODEs 7 and 8) of either or both series devices of an IPFC. Further, when specifying a complex series voltage setpoint in MODEs 4, 7 and 8, it may be specified with respect to either sending end voltage or series current. See *PSS®E Program Operation Manual*, FACTS Device Data, Constant Series Voltage Mode, and IPFC Master and Slave Modes.
- A non-divergent Newton solution option has been added to activities FDNS, FNSL and the AC Contingency Solution, ACCC. See *PSS®E Program Operation Manual,* Section 6.5.3, Non-Divergent Solution Option.
- Several changes were implemented in the Newton-based power flow solution activities FDNS, FNSL, NSOL, INLF and the AC Contingency Solution, ACCC: if the magnitude of the largest voltage change (|delta V|/|V|) exceeds the solution parameter DVLIM, the voltage change vector (and also the angle change vector in the non-decoupled solutions) is scaled back so as to limit the largest such change to DVLIM; if the largest negative (delta V/|V|) is less than or equal to -1.0, the voltage change vector (and also the angle change vector in the non-decoupled solutions) is scaled back so as to keep all voltage magnitudes positive; and the blowup check does not check the largest angle change on the first iteration. See *PSS®E Program Operation Manual,* Section 6.5.1, Characteristics of Activity FNSL.
- The ACCC Contingency Calculation post-processing tools have been revised to accommodate the non-divergent load flow solution option. The Accc Contingency Report includes a new Non-converged report category. The filter dialogs of the Accc Contingency Report and of the AcccBrwsGrid auxiliary post-processing tool for the pc

include maximum bus mismatch and system mismatch tolerances. See *PSS®E Program Operation Manual,* Section 6.10.3, AC Contingency Output and Non-converged Network Conditions.

- In the governor response power flow solution of activity INLF, there are additional options in setting the machine active power limits for machines for which no Inertia and Governor Response Data File record is specified, and for machines for which PMAX is defaulted on the data file record. See *PSS®E Program Operation Manual,* Section 6.8.1, Inertia and Governor Response Data File Contents and Section 6.8.2, Operation of Activity INLF.
- The unit commitment/economic dispatch activity, ECDI, can handle more than two machines as a single entity in its commitment and dispatch calculation. See *PSS®E Program Operation Manual,* Section 5.32, Performing Unit Commitment and Economic Dispatch, Economic Dispatch Data File Contents and Dispatch Groups.
- In initiating activity RAWD from its GUI dialog, the user may elect to output the data records with: IC on the first data record set to 0; IC on the first data record set to 1; or case identification data omitted (i.e., in the form required by activity RDCH). See *PSS®E Program Operation Manual,* Section 5.51, Creating a Transactions Raw Data File.
- Activity OWNM allows the user to change the ownership assignments of FACTS devices and VSC dc lines..
- In the ACCC Reporting Function and in activities DCLF, OTDF, DCCC, TLTG, SPIL, POLY, SCMU, SCOP, ASCC and BKDY, the winding number is included in any output line showing the loading on a three-winding transformer.
- The ***Disturbance>Calculate and Apply Bus Fault*** menu entry of the dynamic simulation activity selector calculates and applies a single unbalanced bus fault.
- The status of each of the simulation options available via the ***Simulation>Simulation Options*** menu entry of the dynamic simulation activity selector is included in the report of the line mode activity DOCU,ALL. It is also included when activity DOCU is initiated via the ***List>Dynamics models and data (DOCU)*** menu entry of the dynamic simulation activity selector, and the List field of the GUI dialog is set to Models by subsystem and the Model type to be processed field is set to All. See *PSS®E Program Operation Manual,* Section 5.2.1, Power Flow Raw Data File Contents.
- The load shed reporting is modified so that the amount of load shed is printed even if a load characteristic model is being used. Thus, for **CIM5/CIMW** type models, the MVA of motor load shed is printed. For **CLOD** type models, the various components that are shed, i.e., MVA of large motors, MVA of small motors, MW of constant real power, Mvar of constant reactive power, MW of discharge real power, MW of remaining real power, Mvar of remaining reactive power, MVA of exciting current are printed. For **IEEL**, **LDFR** and **EXTL** type load characteristic models, the MW and Mvar shed are printed.
- Machine terminal currents and apparent impedances, and load active and reactive powers, may be assigned to simulation output channels via the PLACE command of activity PSAS. See *PSS®E Program Operation Manual,* Section 5.2.1, Power Flow Raw Data File Contents.
- The maximum number of zero impedance lines which may be represented has been increased at all size levels above 4,000 buses. The maximum number of dynamic simulation user-written model definitions has been increased to 100 at all size levels.

- Two new auxiliary programs have been added: CNV29 converts a PSS®E-28 or PSS®E-27 Raw Data File to a Raw Data File in the form required by PSS®E-29; RAW28 outputs a PSS®E Saved Case in PSS®E-28 Raw Data File form. See *Additional Resources for PSS®E*.
- The PSS®E interface routines for use in IPLAN programs include the new subroutines VSCINT, VSCCIN and VSCCDT which return VSC dc line and converter quantities. The SOLVED subroutine indicates the reason convergence was not achieved (e.g., iteration limit reached, solution blown up, etc.). The ORDBUS and NXTBUS subroutines exclude the hidden star point buses of three-winding transformers from the set of buses which they return. See the *IPLAN Program Manual*.

The following new features are added at PSS®E-29.2:

- The REXSYS and REXSY1 excitation system models are modified to reflect WECC modeling changes.
- The LSYSAN activity EIGP now displays eigenvalues using a five digit format.
- In the OPF Solution output report, the Cost value output in the Summary Table for Added Shunt is now in units of $/Mvar. This is consistent with the units used throughout OPF.
- Some unnecessary CALLs to a file flushing routine are removed. As a result, PSSLF4 and PSSDS4 should run somewhat faster, particularly when a Response File executes a very large number of activities over a short period of time.

The following new features are added at PSS®E-29.3:

- In the output report of activity ANSI, a column containing three times the zero sequence symmetrical fault current is added for the L-L-G faults.
- In activity ANSI, detailed output options are added.
- In the OPF Solution activity, the status flag of Period Reserve constraints is now recognized.

The following new features are added at PSS®E-29.4:

- In activity ANSI, the maximum operating voltage is added to the detailed reports, and summary output options using both ANSI R and X are added.
- In activity FNSL, the threshold used in testing for a singular Jacobian has been reduced.
- Activity RAWD now accommodates two digit multipliers on transformer impedance correction table data records.

The following new features are added at PSS®E-29.5:

- In looking for non-converged contingency cases which are close to convergence, the AC Contingency Report function now applies the Bus mismatch tolerance and the System mismatch tolerance only to those contingency cases which were terminated by the non-divergent solution option or due to reaching the iteration limit. Those system conditions which converged in the AC Contingency Solution function are always considered converged by the reporting function. See *PSS®E Program Operation Manual*, Section 6.10.3, AC Contingency Output.

- In the AC Contingency Report function, network conditions that are neither converged nor treated as converged are identified as “NOT CONVERGED” in the Non-spreadsheet overload report.
- The limit processing in STATE(K+3) and STATE(K+9) of the REXSYS and REXSY1 excitation system models was changed to be consistent with current WECC modeling practice.

1.12.5 Program Corrections

The following program errors have been detected and corrected in PSS®E-29.0:

- In using the two-winding and three-winding transformer data editors: if the transformer being edited had CW, CZ and/or CM equal to a value other than 1; one or more data items were changed; the input and output units of a modified data item was governed by one of these non-unity I/O codes; and an echo file was enabled; then the new value was written to the echo file as if the corresponding I/O code were equal to 1 rather than in the units dictated by the I/O code.
- In the GUI dialogs and BAT_ commands for activities DSCN and RECN, if the status of a zero impedance line was changed, the zero impedance line pointer arrays were corrupted.
- In processing contingency cases in activity ACCC, unexpected results could occur in processing a contingency for which: at least one line closure was specified; at least one line trip was specified; none of the branches whose status was changed was a zero impedance line; and these events introduced an island without a type 3 bus.
- In the GUI dialogs for selecting buses for output in activities SCMU and SCOP, the temporary buses 99998 and 99999 could not be successfully selected.
- Activity DRED could incorrectly write the three-winding transformer TT record when outputting a Coordinate Data File under the names output option.
- Several minor errors in the graphical user interface (GUI) were corrected.
- In the PSS®E standard model CDSMS1, the corresponding T entry was never invoked for state-space simulation.
- The PSS®E standard model CIM5BL would result in division by zero at the first time step following a pause if the case has a motor for which the CON (J + 11) < 0.

The following program errors have been detected and corrected in PSS®E-29.1:

- When response ECHOing was enabled, moving loads or machines using the ***Edit>Changing>Move>Load to another bus*** and ***Edit>Changing>Move>Machine to another bus*** menu entries resulted in a program crash.
- In the ACCC solution activity, the largest bus and system total mismatches for contingency cases were calculated incorrectly when VSC dc lines were present in the working case.
- When the ACCC solution activity was executed with the non-divergent power flow option enabled, subsequent executions of ACCC with the non-divergent option enabled would crash with an allocation error.
- Neither the machine sequence data editor nor the Machine sequence data category of activity XLIS allowed the complex zero sequence machine impedance to be set to 0.0 + j 0.0.

- In activity TYSL, when an unblocked VSC dc line was present in the working case, unneeded code which used an uninitialized variable was executed. This could have resulted in an arithmetic fault.
- Activity SCMU produced incorrect results for the one end opened unbalance when the pu distance from the closed end was set to 1.0 (i.e., a line end fault) and the faulted branch was a non-transformer branch.

The following program errors have been detected and corrected in PSS®E-29.2:

- In the ACCC contingency calculation activity, the allocation of active power to the generator buses specified when the DISPATCH token was specified on a REMOVE contingency event record was not handled correctly.
- In power flow solutions, when an unblocked VSC dc line with one converter out-of-service was present in the working case, unneeded code which used an uninitialized variable was executed. This could have resulted in an arithmetic fault.
- The BAT_DCLF command did not work.
- When activity ECDI was initiated from the GUI with response ECHOing enabled, the BAT_ECDI command was written to the ECHO file incorrectly.
- Standard line relay models that were present in dynamics simulation Snapshot Files written by PSS®E-27 and PSS®E-28 were not restored correctly in PSS®E-29.
- When using activity RWDY to generate an Inertia and Governor Response Data File, incorrect values of permanent droop were output for the DEGOV1 and WEHGOV turbine governor models.
- When the Regulate area interchange? OPF solution option was enabled, area interchange constraints were not handled correctly in the OPF solution.
- In the IPLAN simulator, assignment of large REAL values caused integer overflow.
- In the IPLAN simulator, the function FILESEL was not working in line mode.

The following program errors have been detected and corrected in PSS®E-29.3:

- When the PSS®E power output option was set to kVA, those data editors in which active or reactive power values may be edited converted such values to per unit for storage in PSS®E's arrays incorrectly. These editors were restored to behave as documented: such data items are always displayed and specified in MW and Mvar, regardless of the power output option setting.
- In the transformer and switched shunt data editors, when the voltage input option was set to kV, the voltage limit fields may have been handled incorrectly when they represented data items other than voltages (e.g., MW limits for an adjustable phase shifter or reactive power range limits for switched shunts controlling other voltage controlling devices.
- In activity ANSI, there was an error in the handling of zero sequence mutuals. When the case contained zero sequence mutuals, the values calculated and reported for zero sequence Thevenin impedances and the unbalanced faults might have been incorrect. Several other errors in activity ANSI were detected and corrected.
- In the OPF Solution activity, a type 3 bus with more than one connected machine, and all machines having reactive power output beyond their reactive power limits, resulted in a program crash when printing the post-solution swing bus summary.

- In the OPF Solution activity, in-service transformers with RMIN and/or RMAX values of 0.0 caused a zero divide. Such transformers are now fixed at their initial tap settings.
- In the OPF Solution activity, the status flag of Period Reserve constraints is now recognized.

The following program errors have been detected and corrected in PSS®E-29.4:

- In power flow solutions, there was a remote possibility of a divide by zero in assigning a plant's total reactive power output to its machines for a plant with many machines and for which the plant's total reactive power was *very* close to a reactive power limit.
- The ACCC Contingency Calculation function crashed if no monitored branches but at least one monitored interface were specified in the Monitored Element Data File specified to activity DFAX.
- The ACCC Contingency Reporting function omitted voltage rise deviations from the Non-spreadsheet overload report and the Non-spreadsheet loading table.
- In activity DFAX, the SINGLE TIE, DOUBLE TIE and BUSDOUBLE TIE contingency commands could omit some three-winding transformer ties that should have been included as contingency events.
- In transformer data input and data changing, a transformer control mode of +5 or -5 was not detected as an error.
- In changing two-terminal dc line data in activity CHNG, the displayed value of the CCC acceleration factor, CCCACC, was incorrect, and the acceleration factor was not changed to the value entered by the user.
- In activity RAWD, the controlled bus in the transformer record block could be output with the wrong sign.
- Activity DFTI would crash if there were no ac ties from the specified subsystem (e.g., if all working case buses were assigned to the specified subsystem).
- Activity RANK could crash if zero impedance lines were present in the working case at the time it was selected.
- In activity ASCC, there was an error in calculating line end faults on transformers with non-zero phase shift angle when the flat conditions option was not selected. Results were in error when one of the buses was the home bus, and correct when the other one was the home bus.
- In activity ANSI, several errors were corrected:

  L-G fault currents should be zero if the zero sequence Thevenin X is 0.0.

  The asymmetric multiplying factor should not be less than 1.0.

  In the summary output reports, the L-L-G phase current was incorrect.

  In the detailed output report using ANSI X only, transformer grounding impedances with non-zero resistance were not handled correctly.

  In the detailed output reports, L-G zero impedance line currents could be incorrect if a transformer with a connection code of 3 or 4 was connected to any of the buses connected together by zero impedance lines.
- Activity DRED could encounter an error in processing three-winding transformers.

- The OPF Solution could crash if certain invalid network conditions were encountered (e.g., isolated in-service buses).
- In running the auxiliary program CNV27 on a PSS®E-26 Power Flow Raw Data File that used extended bus names as bus identifiers, an extended bus name (e.g., on a branch data record) would have its quotes removed if a bus record for the bus was not included in the input file.
- Several errors in the GUI and Grid Editor were corrected.

The following program errors have been detected and corrected in PSS®E-29.5:

- In moving a single machine (via the ***Edit>Changing>Move>Machine to another bus*** menu entry or the BAT_MOVEMAC command) or load (via the ***Edit>Changing>Move>Load to another bus*** menu entry or the BAT_MOVELOAD command) to another bus with a new identifier specified, the new identifier was ignored unless there already existed at least one machine (or load, as appropriate) at the destination bus.
- When SCALing generation and/or motor active powers with machine limits enforced, activity SCAL could occasionally crash when very large changes were being applied. It could also result in negative active power at generators and/or positive active power at motors.
- When sorting the contingencies to be reported in the “Available capacity table” of the AC Contingency Report function could crash.
- When activity RANK was terminated due to excessive mismatch, it left some temporary arrays allocated. The next activity which attempted to allocate one of these arrays (e.g., DCLF, TLTG, ACCC, and several others) would cause PSS®E to stop due to an allocation error.
- The OPF solution could crash if there were generators in the optimized subsystem whose reactive power generation fell outside of their reactive power limits.
- Following an OPF solution in which the “Minimize adjustable bus shunt” objective was employed, any buses that had both adjustable bus shunts and switched shunts defined had double the resulting OPF adjustable bus shunt value assigned to the bus shunt.
- When a BAT_DYDA record was recorded in a Response File via activity ECHO, and the output of activity DYDA was being directed to a file, execution of the resulting Response File would have activity DYDA output directed to the screen rather than a file.
- When the reporting device was set to a printer and the “print immediate” flag was selected, activity CLOS had no effect.
- Conversion programs RAW23 and RAW26, and any programs written using the PSSLOD subroutine of the Saved Case Data Extraction Subroutines (USRCAS), could crash when processing a Saved Case File containing no loads.
- IPLAN programs could use only 11 file units rather than the documented number of 15.

1.13 PSS®E-28

1.13.1 General

There is complete compatibility between PSS®E-27 and PSS®E-28 at the data input file level. That is, any binary or source data file which could be successfully accessed by PSS®E-27 should also be able to be read by PSS®E-28.

Dynamic simulation Snapshot Files from PSS®E-20 through PSS®E-27 can be read by PSS®E-28.

A dynamics setup used in PSS®E-27 is able to be used in PSS®E-28 without change. The connection routines (CONEC, CONET, USRXXX, USRLOD and USRREL) and user-written models used in PSS®E-27 need only be recompiled.

The connection routines and user-written models used in PSS®E-26 require the addition of the USRREL routine (see Dynamic Simulation of the PSS®E-27 update notes below); the connection routines and user-written models used in PSS®E-25 also require the addition of the USRLOD routine (see Dynamic Simulation of the PSS®E-26 update notes below); those used in PSS®E-20 through PSS®E-24 may require additional minor modifications (see CONEC, CONET, and User Models of the PSS®E-25 update notes below). To access simulation setups from PSS®E-19 or earlier, see the PSS®E-20 update notes below. While a mid-run Snapshot File written by PSS®E-22 or earlier may be accessed with activity RSTR of PSS®E-28, it may not be used for the purpose of continuing the interrupted run; the entire simulation must be executed.

Most PSS®E-28 activities and functions are identical in dialog to those of PSS®E-27. When initiated from the menu bar or via their BAT_ commands, activities DCLF and RANK are terminated rather than prompt for a continue/abort selection when the initial MW mismatch exceeds the MW mismatch threshold tolerance. Further, with the removal of activity WORK (see Section 1.13.2, Load Flow Working File and Activity WORK), any Response Files and IPLAN programs used with PSS®E-27 that use activity WORK need to be modified before they can be used in PSS®E-28.

1.13.2 Load Flow Working File and Activity WORK

At PSS®E-28, PSS®E no longer uses the load flow working file, LFWORK, as a mirror image of the working case contained in data arrays of PSS®E's address space. As a consequence of this change, activity WORK has been removed. Any Response File or IPLAN program which included the use of activity WORK will need to be modified accordingly. The required changes will most likely involve the preserving and retrieving the working case with activities SAVE and CASE, respectively, at appropriate places in the PSS®E execution stream.

1.13.3 Program Corrections

The following program errors have been detected and corrected in PSS®E-28.0:

- CNV27 could reverse a transformer's winding 1, winding 2 side relationship in the PSS®E-27 Power Flow Raw Data File it constructed.
- CNV27 could set an incorrect transformer connection code on the transformer data records in the PSS®E-27 Sequence Data File it constructed.
- Activity DFAX could crash in processing a SINGLE, DOUBLE, BUSDOUBLE, or PARALLEL contingency record which generated no contingency cases.
- The AC Contingency Solution activity, ACCC, could, under a unique set of circumstances, calculate incorrect line loadings on monitored zero impedance lines.

- In activities ASCC and SCGR, A phase results for line-to-ground faults were calculated incorrectly for any transformer with a non-zero phase shift angle.
- When a series FACTS device was placed in constant series impedance mode, the power flow solution activities could fail to converge.
- When initiated from the GUI, activity BGEN could crash when processing a subsystem rather than the entire working case.
- The set of IPLAN routines returning actual area or zone interchanges could return incorrect values when the area interchange option is set to its tie lines plus loads setting, and there are buses with at least one load assigned to the same area/zone that the bus is assigned to, and at least one load assigned to a different area/zone.
- Several minor errors in the data editor windows have been corrected.
- In dynamics, the simulation option to specify a reference machine would alarm an invalid bus number for the specified bus if the bus number exceeded the maximum bus dimensional capacity at which PSS®E was started up. For example, at the 4000 bus size level, specifying as the reference machine A at bus 4001 would fail.
- An array allocation error in the OPF Linear Dependency Constraint model was corrected. This model should now preform reliably.
- The PTOTxx models reported incorrect total load if any LDFRxx, CLODxx or EXTLxx models were present in the subsystem whose totals were being reported (see *PSS®E Model Library,* Section 9.5, CLODBL, CLODOW, CLODZN, CLODAR, CLODAL, Section 9.7, EXTLBL, EXTLOW, EXTLZN, EXTLAR, EXTLAL, and Section 9.9, LDFRBL, LDFROW, LDFRZN, LDFRAR, LDFRAL).

The following program errors were corrected in PSS®E-28 point releases as noted:

- Three-winding transformer losses, or loss totals including any three-winding transformer losses, were reported incorrectly for transformers with two windings in-service and one winding out-of-service. This occurred in activities POUT under the names output option, AREA, ZONE, CMPR and SUBS, and in the ARDAT, ZNDAT, OWDAT and SYSTOT IPLAN subroutines. (28.1.0)
- Activity FNSL incorrectly identified the bus with the largest voltage magnitude change in its convergence monitor. (28.1.0)
- Several errors were corrected in the AC Contingency Solution (ACCC) function when the full Newton-Raphson method was selected as the solution method to be employed. (28.1.0)
- The ACCC Report function incorrectly set the previous Saved Case File name to that contained in the ACCC Contingency output file. (28.1.0)
- PSS®E terminated with an internal error when adding a machine to the working case using the Plant & Machine data editor. (28.1.0)
- In activities DCCC, TLTG, SPIL and POLY, unpredictable side effects could occur (e.g., an infinite loop) in processing contingency cases following a contingency case solution which required a full dc network solution. (28.1.0)
- In activity ANSI, when the Account for DC decrement only option was selected, the calculation used the tables for the Account for AC and DC decrements option, and vice versa. (28.1.0)

- Activity SCGR would crash when a second set of fault calculations was initiated via the G-FAULT menu command of the graphic display. (28.1.0)
- Activity OWNM would show that no network elements were assigned to an owner if FACTS devices were the only equipment items remaining assigned to the owner. (28.1.0)
- On bus records output by activity RWCM, for buses with generation controlling voltage at a remote bus, the remote bus field was in error for generator buses whose external bus number was less than that of its remotely controlled bus. (28.1.0)
- The LDFRxx dynamics model family incorrectly calculated the incremental variation in load due to frequency effects (see *PSS®E Model Library*, Section 9.9, LDFRBL, LDFROW, LDFRZN, LDFRAR, LDFRAL). (28.1.0)
- Several minor errors in the graphical user interface (GUI) were corrected. (28.1.0 and 28.1.3)
- An error in the mechanical power calculation of the PIDGOV governor model resulted in suspect initial conditions in activity STRT. (28.1.2)
- An error in initializing the REXSYS excitation system model resulted in suspect initial conditions in activity STRT. (28.1.2)
- The AC Contingency Solution function crashed when phase shift adjustment was enabled and the full Newton-Raphson network solution method was being used. (28.1.3)
- The SC Contingency Solution function printed extra blank lines in the progress area when all of the following conditions applied: convergence monitors were suppressed; automatic adjustments were enabled; and the full Newton-Raphson network solution method was being used. (28.1.3)
- In using activity CHNG to modify two-winding transformer data, the response of a zero to the CHANGE IT? prompt for one of the groups of data items resulted in a repeat of the same group of data items rather than advancing to the next group. (28.1.3)
- In activities READ, RDCH and TREA: if a transformer data record was read for a two-winding transformer which was already present in the working case as a non-transformer branch; and if sequence data was included in the working case; then the zero sequence impedance of the transformer was left at the value previously specified for the non-transformer branch rather than being set to the positive sequence impedance of the transformer. (28.1.3)
- When activities DCCC, TLTG, SPIL and POLY processed contingencies involving a status change of a zero impedance line, and a full dc power flow solution, rather than solution by distribution factor methods, was required (e.g., a contingency which outages three lines, one of which is a zero impedance line), unexpected behavior occurred in processing subsequent contingencies. (28.1.3)
- Activity SCMU corrupted the zero sequence branch impedance array under either of the following conditions: (28.1.3)
  - The working case contained transformer impedance correction tables, at least one transformer had its actual positive sequence impedance changed from its nominal value through its association with an impedance correction table, and, in activity SEQD, impedance correction was also applied to the zero sequence impedances of such transformers.

  - Either the one end opened or the in-line slider unbalance was applied in activity SCMU.

- When changing sequence data with the data editors with ECHOing enabled, data changes were captured incorrectly in the Response File. (28.1.3)
- When adding a machine with a single character machine identifier to the working case using activity DRED, a garbage character rather than a blank was assigned as the second character of the machine identifier. (28.1.3)
- When adding a three-winding transformer to a one-line diagram using activity DRED, the resulting Coordinate Data File could contain garbage in the from bus field of an LI,TN record. (28.1.3)
- The fault reporting of activities SCMU and SCOP, along with the corresponding IPLAN programs SCBUS2 and SCBRN2, were unable to produce output for the temporary buses 99998 and 99999 when: the one end opened or fault slider was selected in activity SCMU; there were three winding transformers in the case; and output for one of these temporary buses was specifically requested. (28.1.4)
- In processing line out faults in activity ASCC, unexpected results could occur when applying a fault at the home bus with a three-winding transformer automatically outaged. (28.1.4)
- In the Fault current summary table report of activity ASCC, for line out and line end faults involving a three-winding transformer, the star point bus and one of the transformer winding buses was listed as the branch involved in the fault, rather than the three-winding transformer. (28.1.4)
- In processing contingency cases in activity ACCC, unexpected results could occur when the Distribution Factor Data File, and hence the Contingency Description Data File that was specified to activity DFAX, contained at least one contingency case that included both the boundary condition contingency events and either one or two line outage contingency events. (28.1.4)
- The AC Contingency Solution reporting function could fail to report some buses that belonged to monitored voltage subsystems. (28.1.5)

1.14 PSS®E-27

1.14.1 General

With the exception of the Power Flow Raw Data File and Sequence Data File formats, there is complete compatibility between PSS®E-26 and PSS®E-27 at the data input file level. That is, any other binary or source data file which could be successfully accessed by PSS®E-26 should also be able to be read by PSS®E-27.

At PSS®E-27, provision is made for calling a new set of line relay models from internal PSS®E tables; that is, the use of these models requires no calls in subroutine CONET. Nonetheless, a dynamics setup used in PSS®E-26 is able to be used in PSS®E-27 almost without change. Dynamic simulation Snapshot Files from PSS®E-20 through PSS®E-26 can be read by PSS®E-27. Other than the addition of the USRREL routine (see Dynamic Simulation), the connection routines CONEC and CONET and user-written models used in PSS®E-26 need only be recompiled; the connection routines CONEC and CONET and user-written models used in PSS®E-25 also require the addition of the USRLOD routine (see Dynamic Simulation of the PSS®E-26 update notes below); those used in PSS®E-20 through PSS®E-24 may require additional minor modifications (see CONEC, CONET, and User Models of the PSS®E-25 update notes below). To access simulation setups from PSS®E-19 or earlier, see the PSS®E-20 update notes below. While a mid-run Snapshot File written by PSS®E-22 or earlier may be accessed with activity RSTR of PSS®E-27, it may not be used for the purpose of continuing the interrupted run; the entire simulation must be executed.

The majority of PSS®E-27 activities and functions are identical in dialog to PSS®E-26. The dialog changes that have occurred are described below. Any Response Files and IPLAN programs used with PSS®E-26 that use any of these line mode dialog streams and/or BAT_ commands need to be modified before they can be used in PSS®E-27.

- In activities READ, RDCH and TREA, the Non-Transformer Branch Data and Multi-Section Line Grouping Data record formats have been changed, and the tap adjustment data records have been replaced by Transformer Data record blocks. Refer to Power Flow Raw Data File and Sequence Data File.
- In activities RESQ and TRSQ, zero sequence branch data records are now Zero Sequence Non-Transformer Branch Data records in which data records for transformers may not be specified, and the transformer grounding code data records have been replaced by Zero Sequence Transformer Data records. Refer to Power Flow Raw Data File and Sequence Data File.
- In activity CHNG, category 4, formerly transformer data, is now two-winding transformer data, and the response stream is completely different.
- In activity SQCH, category 3, formerly zero sequence branch data, is now zero sequence nontransformer branch data; transformer branches may not be specified in this category. A new category, 5, is used to change the zero sequence data of two-winding transformers.
- In activity SQLI, line shunts are now reported with branch data, and category 5, formerly line shunt data, is now two-winding transformer data.
- The calculation and reporting phases of activity ACCC has been split into separate functions. See Section 1.14.5, Activity ACCC.
- In activity CNTB, the new out-of-service option has resulted in an additional prompt in the line mode dialog, and an additional integer input value required in the BAT_CNTB command.
- In activity DCLF, providing for changing the status of a three-winding transformer has resulted in additional prompt in the names input mode of the line mode dialog, and an additional integer input value required in the BAT_DCLF command.
- In activity TPCH, because of the transformer model changes (see Section 1.14.2, Transformers), the ratio band not a multiple of tap step test has been removed. Test 7 is now unused.
- In activity DYRE, the prompt for a file for PSSPLT relay characteristic data has been removed. Records for line relay models are now output by activity RWDY. The creation of PSSPLT relay characteristic data records for the LOEXR1 model is no longer automated.
- In activities DOCU and DYDA, the numeric response codes in the model type selection prompt for CONEC models and CONET models (and CHAN models in activity DOCU) have each been increased by one. Corresponding changes have been made in the values used in the STATUS(3) value passed to the BAT_DOCU command and in the STATUS(2) value passed to the BAT_DYDA command.

1.14.2 Transformers

The PSS®E transformer model is completely redesigned for PSS®E-27. Additional options for the units of input data are provided so that, in many cases, nameplate data may be used without change; thus, the need to derive input data from nameplate data is reduced or eliminated. The new transformer model is a more realistic model which also includes provision for modeling a three-winding transformer.

The major differences between the PSS®E-26 transformer model and the new two-winding transformer model are:

- The old tapped side is now referred to as the winding one side, and, as before, its tap ratio or phase shift angle may be automatically adjusted by the power flow solution activities.
- The old untapped side is now referred to as the winding two side, and it now provides for an off-nominal fixed tap ratio.
- The winding one side positive sequence line shunt models magnetizing admittance.
- Line charging and winding two side line shunt in the positive sequence are **not** included in this model.
- Zero sequence line charging and line shunt are **not** included in this model.
- The tap step of the old model is replaced by a number of tap positions data item.

The new model requires changes to both the Power Flow Raw Data File and Sequence Data File formats.

When activity CASE accesses a Saved Case File from PSS®E-26 or earlier, transformers with nonzero values of charging and untapped side line shunt in the positive sequence are logged at the progress report output device (see *PSS®E Program Operation Manual*, Section 4.4, Virtual Output Devices); charging is set to zero, and the winding two side line shunt is added to the winding one side line shunt and then the second winding side line shunt set to zero. In the zero sequence, nonzero transformer charging and line shunts are logged and set to zero. Nonzero values of line length for transformers are set to zero but are not logged.

1.14.3 Power Flow Raw Data File and Sequence Data File

The following are the changes to the Power Flow Raw Data File format:

- The branch data record is now a Non-Transformer Branch Data record. The RATIO and ANGLE fields have been removed, and such a record is specified only for nontransformer branches.
- The transformer adjustment data category has been replaced with the Transformer Data category, which consists of a transformer data record block for each transformer. Each two-winding transformer is specified in a block of four consecutive data records; each three-winding transformer block consists of five consecutive data records.
- The Multi-Section Line Grouping Data record has been changed to eliminate the specification of redundant information. The circuit identifiers of the member branches no longer need be specified.

The following are the changes to the Sequence Data File format:

- The zero sequence branch data record is now a Zero Sequence Non-Transformer Branch Data record. Such a record is specified only for nontransformer branches.
- The transformer grounding code category has been replaced with the Zero Sequence Transformer Data category.

A format conversion program, CNV27 (see *Additional Resources for PSS®E Program Operation Manual*) is supplied with PSS®E-27 which converts Power Flow Raw Data Files and their corresponding Sequence Data Files from the formats required in PSS®E-24 through PSS®E-26 to those required in PSS®E-27. It handles charging and line shunts in the same manner as does activity CASE (see Section 1.14.2, Transformers).

1.14.4 Dynamic Simulation

Table-Driven Models

At PSS®E-27, a new set of line relay models has been developed which are called from internal PSS®E tables. This is similar to the approach used for plant-related and load-related models in that the use of these models does **not** require calls in subroutine CONEC or CONET. A detailed discussion of the new model set can be found in the PSS®E *Program Application Guide*. The new set of models supersedes the pre-PSS®E-27 set of CONET line relay models.

Each Dynamics Data Input File model data record referencing one of the old line relay models is converted internally by activity DYRE to one of the new table-driven line relay models. Activity DYRE notifies the user of each conversion that takes place. The following table summarizes the conversion process:

Old Model	Converted To
CIRCOS	CIROS1
DISTR	DISTR1
DPDTRE	DPDTR1
RXR	RXR1
SCGAP1	SCGAP2
SLINOS	SLNOS1
SLLP	SLLP1
SLYPCN	SLYPN1
TIOCRE	TIOCR1

In all cases, the ICON list between the old model and new model to which it is converted is modified. The old model set contained ICON space for specifying the branch to which the model was applied. Several of the models had ICON space for specifying the frequency with which the model was to be called (Resolution). Several models contained ICON space for specifying a Reference number. The above elements, as well as several others which are model dependent, have been removed. In several of the models, additional ICON space is required. Utilization in the CON and VAR arrays is identical in the old and new models.

Each CIROS1 and SLNOS1 model reference may be used as a supervisory relay of a CIROS1, DISTR1, RXR1, SLLP1 or SLNOS1 model. Prior to PSS®E-27, this was done by editing the model's CALL statement in subroutine CONET to include the appropriate permissive flag ICON index of the supervised relay model. At PSS®E-27, the CIROS1 and SLNOS1 models have ICON space reserved into which the user places the appropriate permissive flag ICON index via the line relay data editor (see *PSS®E Program Operation Manual*, Dynamics Model Raw Data File Contents) or activity ALTR.

At PSS®E-27, a set of simulation calculation options is introduced. The set of calculation and monitoring functions enabled via these simulation options supersedes the pre-PSS®E-27 set of system-wide models called from subroutines CONEC and CONET: NETFRQ, OSSCAN, GNSCN1, GNSCN2, RELAY1, VSCAN, RELANG, and SYSANG.

Each Dynamics Data Input File model data record referencing one of the old system-wide models triggers an alarm by activity DYRE, instructing the user to enable the corresponding calculation or monitoring function either by selecting the ***Simulation>Simulation Options*** function from the dynamic simulation activity selector or via activity CHSB,ANGLES (see *PSS®E Program Operation Manual,* Section 5.2.1, Power Flow Raw Data File Contents). No CONEC or CONET model call is generated.

At PSS®E-27, two options for handling dynamic simulation setups from PSS®E-26 which include calls in subroutines CONEC and/or CONET to any of the old line relay models and/or system-wide are available.

1. The old setup may be used. The only change required is the addition of the following code to the bottom of the file containing the FLECS code of subroutine CONEC:

   ```
   SUBROUTINE USRREL(KM,RI,SLOT,IT)
   INTEGER KM,RI,SLOT,IT
   SELECT (IT)
   (OTHERWISE) CALL URALRM(KM,IT)
   FIN
   RETURN
   END
   ```

   Then the modified CONEC file, the original CONET file, and any user-written models used in the simulation need to be recompiled, and PSS®E relinked. Using this approach, dynamic simulations are executed using the old line relay and system-wide models called from subroutines CONEC and CONET.

   The file *conec.flx* in the PSS®E Example subdirectory contains the default version of the USRREL subroutine as well as those of the USRXXX and USRLOD subroutines.

2. Recompile the CONEC and CONET files containing the calls to the old line relay and/or system-wide models and relink PSS®E. Pick up the old Snapshot File and use activity DYDA to produce a Dynamics Data Input File, which will include data records for the old line relay and/or system-wide models. Use activity DYRE to read the Dynamics Data Input File.

   As described above, activity DYRE converts the old line relay model data records to models from the new set. Up to two relay models are allowed at each end of a two-terminal ac branch. They are assigned to relay slots one and two in the order in which they are introduced into PSS®E. If more than two line relays are specified at the same end of a line, activity DYRE prints an appropriate message and ignores all but the first two.

   As described above, activity DYRE alarms and ignores the old system-wide model data records. The ***Simulation>Simulation Options*** dialog or activity CHSB must be used to activate the corresponding calculation or monitoring function of each alarmed old system-wide model.

Dynamics memory should then be preserved with activity SNAP, the new CONEC and CONET files recompiled, any user-written models used in the simulation recompiled, and PSS®E relinked.

PTI recommends that the second procedure eventually be employed. This avoids potential model conflicts when new line relay models are introduced into an existing simulation model by activity DYRE,ADD. Further, the old line relay and system-wide models are considered obsolete and will be removed from PSS®E at a future program release.

WESGOV Model

The Westinghouse digital gas turbine governor model, WESGOV, has been changed based on information supplied by the manufacturer. The digital control limit, ALIM, is now a windup limit; in prior releases of PSS®E, this limit was implemented as a non-winding limit.

Dynamic Simulation Windows Mode Changes

The graphical user interface dialog of activity CCON has been replaced by the ***Edit>Plant Model>Add/Edit constants*** function accessible from the dynamic simulation activity selector window. Similarly, the plant-related model table maintenance functions available in activity DYCH are now also accessible from the ***Edit>Plant Model*** menu.

The graphical user interface dialog of activity ALTR no longer provides access to network data changes. Rather, network data changes may be implemented via the power flow data editors which are now directly accessible from the dynamic simulation activity selector window under the ***Edit>Loadflow data*** menu. The line mode implementation of activity ALTR is unchanged, so that existing Response Files and IPLAN programs which imposed network data changes via activity ALTR should be able to be used without modification.

1.14.5 Activity ACCC

Activity ACCC has been revised. It is now divided into two AC Contingency Solution functions: a solution process and a reporting process. The solution process deposits results into a binary output file which is subsequently input to the reporting process. The prior ACCC line mode dialog is preserved for the solution process but has been modified to provide a prompt for the output file and to provide for fewer solution parameters. Existing Response Files and IPLAN programs which push ACCC command responses should be modified to provide for an output file and to limit parameter menu responses to item one only.

The AC Contingency Solution overload and loading table reports are available in their prior format as well as new formats which are suitable for import into a spreadsheet program. Filter criteria on bus voltage conditions and island conditions are provided to aid in controlling the information presented in the reports.

1.14.6 OPF Models Extended Throughout PSS®E

Load flow, short circuit, and dynamic simulation functions have been modified to recognize the Optimal Power Flow load multipliers and adjustable branch reactance devices.

The load multiplier is a member field of the adjustable bus load table. Loads presented to the power flow solution activities include the effects of any load multipliers. Load multiplier values do not affect the zero sequence shunt load. Activities EXAM and LIST list any load multipliers applied to reported loads. Dynamic simulation load models have been modified to recognize the load multipliers, with the exception of the following obsolete models: EXTLD2, CIMTR5, CIMWSC, CLOAD, CMOTOR,

IEELCA, IEELCB, IEELCZ, LDSHD2, LDSHD3, LOADF, LOADFA, LOADFZ, DLODSH, LODSHD, LVSHD3, TOTA, and TOTZ.

The Optimal Power Flow adjustable branch reactance model may adjust the reactance values of ac branches. The adjusted reactance is recognized and employed by functions and models throughout PSS®E. The nominal branch reactance and the reactance multiplier may be modified independently. The nominal branch reactance value is interrogated to identify zero impedance branches. Activity EXAM identifies the reactance multiplier magnitude, nominal reactance magnitude, and status for adjustable branch reactance devices. Branch reactance multipliers contained in Saved Case Files created by prior program releases are set to 1.0 on input. This is done to preserve the power balance of the network introduced by the Saved Case. The non-unity branch reactance multiplier values may be preserved by employing OPF raw data created from the prior program release.

1.14.7 Program Corrections

The following program errors have been detected and corrected in PSS®E-27.0:

- In activities using the Distribution Factor Data File produced by activity DFAX, incorrect results were produced if duplicate branch contingency events were specified in a contingency.
- Activity ACCC gave inconsistent results when invoked more than once from the GUI,
- Activity GDIF could crash if the Drawing Coordinate Data file contained records for open-ended radial lines.
- Activities TLTG, SPIL and POLY could crash if the number of subsystems defined was one less than the number required (two in TLTG and SPIL, three in POLY), and therefore the subsystem WORLD, defined as the rest of the working case, was automatically generated.
- When a negative generation shift was specified in activity SPIL, an incorrect detection of an insoluble system condition could be reported.
- In activity SCEQ, the optional output files could be left open if the working case was not in the form required. When initiated from the GUI, the boundaries of the subsystem to be equivalenced could get set incorrectly.
- Activity SUBS could crash if any FACTS devices were present in the working case.
- In activity DYRE, conversions of the old LOADFA and LOADFZ models to the new LDFRxx model set inadvertently shuffled the CON data values (see *PSSS®E Model Library*, Section 9.9, LDFRBL, LDFROW, LDFRZN, LDFRAR, LDFRAL).
- Simulations using the NETFRQ model could crash if the simulation employed a post-STRT Snapshot and activity STRT was not executed in the current PSSDS4 session.
- In the user model URHYDD, the gain K2 was implemented twice, resulting in an effective gain of $K2^2$. This is corrected in the model WSHYDD, which replaces URHYDD.
- Several stabilizer models which can sense accelerating power (IEEEST, IEE2ST, PSS2A, ST2CUT and STBSVC) and the subsystem totals models which calculate subsystem accelerating power (PTOTOW, PTOTZN, PTOTAR, PTOTAL) calculated it incorrectly for machines with non-zero values of resistance in ZSORCE and/or XTRAN.
- In the data checking mode of activity DOCU, B5 of the model PTIST3 was incorrectly flagged as causing a fatal error.

- Activity MCAS of LSYSAN incorrectly detected an input error in reading the specified source data file.

The following program errors were corrected in PSS®E-27 point releases as noted:

- Activity TLST could fail if there were no controlling transformers in the case. (27.0.1)
- Activity CASE failed to ensure that NTAPOS was at least two in picking up old cases. This could cause a subsequent crash if the working case was subsequently saved, and then accessed with the auxiliary programs RAW23 and RAW26. (27.0.2)
- In converting transformer data to the new transformer data record blocks, the auxiliary program CNV27 could, as a result of incorrect arithmetic rounding, set the data item NTP (number of tap positions) to one less than the value it should have been. (27.0.2)
- With echo mode enabled, commands for activity JOIN initiated via the GUI were not captured in the Response File, and commands for modifying branch and three-winding transformer data via the GUI were captured incorrectly. (27.0.2)
- PSS®E could crash in adding or changing two-winding transformer data. (27.0.2)
- The two-winding transformer data editor could crash when APPLYing data changes for a transformer which has a transformer impedance correction table assigned to it. (27.0.2)
- When reading a new case with activity READ, a spurious BUS NUMBER ALREADY IN USE error message could have been printed for the first bus record encountered. (27.0.2)
- The series reactor FACTS dynamics model, CRANI/TRANI, could have caused PSS®E to terminate with an array allocation error. (27.0.2)
- The magnetizing current of transformers was set with the wrong sign when CM was specified as 2. (27.1)
- If a non-transformer branch which was being treated as a zero impedance line was converted to a two-winding transformer, it still retained its entry in the zero impedance line tables. (27.1)
- Activity ACCC could incorrectly label interfaces in the non-spreadsheet overload report. (27.1)
- The AC Contingency Solution reporting function did not include the option to Exclude cases with no overloads from non-spreadsheet overload report. (27.1)
- In activities ASCC and SCGR, line out and line end faults for transformers with a non-zero zero sequence grounding impedance and a connection code of 2 or 3 may have been calculated incorrectly under the flat option. (27.1)
- The bus data portion of the output of activity SQLI inadvertently reported the hidden star point buses of three-winding transformers. (27.1)
- Activity SCEQ could crash if zero impedance lines are present in the subsystem being equivalenced and one or more of them were to be equivalenced out. (27.1)
- Several minor errors were corrected in activities DRAW, DRED, GOUT and GEXM: in DRAW, summation blocks involving multi-section lines were calculated incorrectly; in DRED, open ended radial lines occasionally disappeared from drawings after saving the diagram coordinates in the .drw file; in GOUT, mismatches in a multi-page display were reported incorrectly whenever a three-winding transformer or FACTS device was

connected to the bus; and in GEXM and GOUT, incorrect data was displayed for FACTS devices whose FACTS device number was greater than the number of FACTS devices in the case. (27.1)

- Activity DYRE did not allow a user-written multi-terminal dc line model unless a two-terminal dc line with the same dc line number was in the case. (27.1)

1.15 PSS®E-26

1.15.1 General

Two-terminal dc line modeling has been enhanced to accommodate capacitor commutated converters (CCC). Dynamics models for dc lines with one or both converters represented as capacitor commutated converters are not yet included in the simulation model library.

Flexible AC Transmission System (FACTS) device modeling has been added to PSS®E-26. No dynamics models interfacing with the new FACTS control device data structure are included in the simulation model library.

While these changes have an impact on the Power Flow Raw Data File, the format changes involve additional data items at the ends of the three data records used to define each two-terminal dc line, and a new data category for FACTS devices at the end of the file. Simply adding a record containing a zero to the end of a PSS®E-25 Power Flow Raw Data File allows it to be read by PSS®E-26.

With the exception of the Power Flow Raw Data File (see above), there is complete compatibility between PSS®E-25 and PSS®E-26 at the data input file level. That is, any other binary or source data file which could be accessed successfully by PSS®E-25 should also be able to be read by PSS®E-26.

At PSS®E-26, provision is made for calling a new set of load characteristic and load relay models from internal PSS®E tables; that is, the use of these models requires no calls in subroutines CONEC and CONET. Nonetheless, a dynamics setup used in PSS®E-25 is able to be used in PSS®E-26 almost without change. Dynamic simulation Snapshot Files from PSS®E-20 through PSS®E-25 can be read by PSS®E-26. Other than the addition of the USRLOD routine (Dynamic Simulation), the connection routines CONEC and CONET and user-written models used in PSS®E-25 need only be recompiled; those used in PSS®E-20 through PSS®E-24 may require additional minor modifications (see CONEC, CONET, and User Models of the PSS®E-25 update notes below). To access simulation setups from PSS®E-19 or earlier, see the PSS®E-20 update notes below. While a mid-run Snapshot File written by PSS®E-22 or earlier may be accessed with activity RSTR of PSS®E-26, it may not be used for the purpose of continuing the interrupted run; the entire simulation must be executed.

The majority of PSS®E-26 activities and functions are identical in dialog to PSS®E-25. The dialog changes that have occurred are described below. Any Response Files and IPLAN programs used with PSS®E-25 that use any of these line mode dialog streams and/or BAT_ commands need to be modified before they can be used in PSS®E-26.

- Three OPF BAT_ commands have been changed. In the BAT_AXOPVR and BAT_AXOBFL commands, an additional ID data value has been added in the middle of their data lists to accommodate the ability to automatically add new shunts and branch flow constraints within a selected subsystem. There have also been some additions to the BAT_OPTO command in both the integer and real array lists.

- In activities DOCU and DYDA, the numeric response codes in the model type selection prompt for CONEC models and CONET models (and CHAN models in activity DOCU) have each been increased by two. Corresponding changes have been made in the values used in the STATUS(3) value passed to the BAT_DOCU command and in the STATUS(2) value passed to the BAT_DYDA command.

Activity DOCU now reports channel models only when they are explicitly requested. Channel models are explicitly requested by the following program interactions:

- Typing DOCU,CH from the command line.
- Employing BAT_DOCU with STATUS(2) = 2, from the command line.
- Selecting ***All CHAN model***s from the List Dynamic Model Data dialog.
- Entering DOCU from the command line with no suffix or with a subsystem selection suffix and selecting menu item 14 when prompted to `SELECT MODELS TO BE PROCESSED`. (Note that channel models are now excluded from the report when selecting menu item 1.)
- Employing BAT_DOCU with STATUS(2) = 3, and STATUS(3) = 14, from the command line.
- Selecting the combination of ***Models by subsystem*** and Model type to be processed ***CHAN*** from the List Dynamic Model Data dialog.

Channel models are excluded from the report for all other variations of interaction with activity DOCU.

1.15.2 Dynamic Simulation

At PSS®E-26, a new set of load characteristic and load relay models has been developed which are called from internal PSS®E tables. This is similar to the approach used for plant-related models in that the use of these models does **not** require calls in subroutine CONEC or CONET. A detailed discussion of the new model set can be found in the *PSS®E Program Application Guide*. The new set of models supersedes the pre-PSS®E-26 set of CONEC and CONET load-related models.

Each Dynamics Data Input File model data record referencing one of the old load-related models is converted internally by activity DYRE to one of the new table-driven load-related models. Activity DYRE notifies the user of each conversion that takes place. The following table summarizes the conversion process.

Old Model	Converted To
CIMTR5	CIM5BL
CIMWSC	CIMWBL
CLOAD	CLODBL
CMOTOR	CIM5BL
DLODSH	DLSHBL
EXTLD2	EXTLBL
IEELCA	IEELAR (IEELAL when ICON(I)=0)
IEELCB	IEELBL (IEELAL when ICON(I)=0)
IEELCZ	IEELZN (IEELAL when ICON(I)=0)
LDSHD2	LDSTBL

Old Model	Converted To
LDSHD3	LDS3BL
LOADF	LDFRBL (LDFRAL when ICON(I)=0)
LOADFA	LDFRAR (LDFRAL when ICON(I)=0)
LOADFZ	LDFRZN (LDFRAL when ICON(I)=0)
LODSHD	LDSHBL
LVOSHD	LVSHBL
LVSHD3	LVS3BL

At PSS®E-26 there is a change in the manner in which load-related models are attached to the network. Except for CIMTR5 and CIMWSC, models from the old set were specified for a bus, and were applied to all loads at the bus. Models in the new set are specified for an individual load. The conversion process assigns a wildcard load identifier ('*'; see *PSS®E Program Operation Manual*, Load Characteristic Models) to the new model.

In all cases, the ICON list between the old model and new model to which it is converted is modified. The old model set contained ICON space for specifying the bus, area, or zone number which identified the bus(es) at which the model was to be applied. These elements have been removed. In the new models corresponding to CIMTR5 or CIMWSC, the ICON space for the Load Identifier has also been removed.

In many cases, there is a one-to-one correspondence between the CON data list for the old model and the new model to which it is converted. Exceptions are as follows:

1. LODSHD to LDSHBL LDSHD2 to LDSTBL DLODSH to DLSHBL	The LODSHD CON(K+10) is removed. This CON specified the 'nominal shunt MVAR not subject to load shedding'. This data element is obsolete.
2. LOADF to LDFRBL	The LOADF CON(J), Current Load Exponent, is expanded in to two separate LDFRBL CONs, one for the real and one for the reactive components of current load. The data for each of the new CONs is assumed to be equal to the value of the original LOADF CON(J).
3. CMOTOR to CIM5BL	The following obsolete CMOTOR data elements are removed: Initial condition slip CON(M+3). Local acceleration, CON(N). The following default data is added to the CIM5BL model: Saturation; CON(J+7) through CON(J+10) set to zero. Motor tripping data; CON(J+14) through CON(J+16) set to zero. MBASE as load multiple, PMULT; CON(J+12) set to zero. The CMOTOR to CIM5BL induction motor model conversion represents an increase in modeling detail. This conversion may require the user to reduce the integration time step used for dynamic simulation. The user should refer to the *PSS®E Program Application Guide*, for more information.

Furthermore, VAR space in several models from the old set, which was reserved for storing the total load output of the model, is removed during the conversion process. This includes the models CIMTR5, CIMWSC, CLOAD, and CMOTOR. At PSS®E-26, the effective load may be monitored by assigning the load to an output channel in activity CHSB or CHAN.

At PSS®E-26, the TOTA and TOTZ models have been replaced by a new set of monitoring functions available through activity CHSB. Existing CONEC files which contain calls to these models may still be used; however, activity DYRE at PSS®E-26 does not recognize data records for these models and instructs the user to use activity CHSB to enable these calculations. The new CSHB subsystem functions have been enhanced beyond the capabilities of TOTA and TOTZ. Refer to the discussion of activity CHSB in the *Program Operation Manual* for further details.

At PSS®E-26, two options for handling older dynamic simulation setups which include calls in subroutines CONEC and/or CONET to any of the old load-related models are available:

1. The old setup may be used. The only change required is the addition of the following code to the bottom of the file containing the FLECS code of subroutine CONEC:

```
SUBROUTINE USRLOD(LD,SLOT,SLOT2,IT)
INTEGER LD,SLOT,SLOT2,IT
SELECT (IT)
(OTHERWISE) CALL ULALRM(LD,IT)
FIN
RETURN
END
```

   Then the modified CONEC file, the original CONET file, and any user-written models used in the simulation need to be recompiled, and PSS®E relinked. Using this approach, dynamic simulations are executed using the old load-related models called from subroutines CONEC and CONET.

   The file *conec.flx* in the PSS®E Example subdirectory contains the default version of the USRLODL subroutine as well as that of the USRXXX subroutine.

2. Recompile the CONEC and CONET files containing the calls to the old load-related models and relink PSS®E. Pick up the old Snapshot File and use activity DYDA to produce a Dynamics Data Input File, which will include data records for the older load-related models. Use activity DYRE to read the Dynamics Data Input File. As described above, activity DYRE converts the old load-related model data records to models from the new set. Dynamics memory should then be preserved with activity SNAP, the new CONEC and CONET files recompiled, any user-written models used in the simulation recompiled, and PSS®E relinked.

PTI recommends that the second procedure eventually be employed. This avoids potential model conflicts when new load-related models are introduced to an existing simulation model by activity DYRE,ADD. Further, the old load-related load-related models are considered obsolete and will be removed from PSS®E at a future program release.

1.15.3 Newton Power Flow Solutions

Prior to PSS®E-26, the Newton-Raphson-based power flow solution activities (FNSL, FDNS, NSOL, AC Contingency Solution, and INLF) used the Newton convergence tolerance setting in that part of its Mvar limit checking logic which attempts to avoid the phenomenon of a generator bus alternating either on and off a Mvar limit, or between its high and low Mvar limits, on successive iterations. This approach imposed the undocumented restriction that the difference between the plant high and low Mvar limits be wider than this tolerance at all type two buses with unequal Mvar limits. If this restriction was violated, the Newton iteration could diverge.

Just prior to the release of PSS®E-25, this restriction, combined with precision limitations, caused a problem in activity ACCC for a PSS®E user. To address this problem for PSS®E-25, activity ACCC was changed so that if the initial working case mismatch exceeded the mismatch threshold tolerance specified at the start of its execution, it was no longer aborted.

At PSS®E-26, the behavior of activity ACCC is restored to that of PSS®E-24 and earlier; it does not allow itself to be executed if the working case mismatch exceeds the tolerance specified at the start of activity ACCC. In addition, the Newton-based solution activities listed above have been changed so that the solution convergence tolerance is no longer used in the Mvar limit logic. In this logic, the difference between the plant high and low Mvar limits must be greater than 0.002 pu at all type two buses with unequal Mvar limits (0.2 Mvar on a 100 MVA system base); it is recommended that machines with unequal Mvar limits have Mvar ranges substantially wider than this minimum permissible limit.

1.15.4 Program Corrections

The following program errors have been detected and corrected in PSS®E-26.0:

- In activity SCAL, when scaling reactive load to a specified power factor for a load with a nonzero active constant admittance load, the reactive component of admittance load was generated with the wrong sign.
- Activities LTAP and SPLT could crash if the working case contained optimal power flow (OPF) data.
- In activity LTAP, multisection lines were sometimes incorrectly deleted.
- If any of the line mode activities AREA,AREA, ZONE,ZONE, INTA,AREA, INTZ,ZONE, TIES,AREA and TIEZ,ZONE was preceded by the execution of an activity whose processing or reporting was restricted to selected owners, following the prompt for specifying areas or zones, the user was instructed to `ENTER UP TO 20 OWNERS`.
- In the Monitored Element Data File read by activity DFAX, if the optional token MONITOR was omitted from one of the MONITOR VOLTAGE records, the record was treated as a flow monitoring record and unexpected results occurred.
- In activity ACCC zero impedance line flows were sometimes calculated incorrectly when a switched shunt was present at one or more of the zero impedance line connected buses, or if one of the buses was a dc converter bus.
- During activity ACCC, if a zero impedance line and a branch not being modeled as a zero impedance line connected the same pair of buses and both were in-service, a contingency case that included the outaging of the branch not being modeled as a zero impedance line with the zero impedance line left in-service could cause PSS®E to terminate abnormally.

- Activities TLTG, SPIL, and POLY terminated abnormally at the error stop SUTIES-1 when all of the following conditions were satisfied:
  - The multisection line reporting option was enabled.
  - There existed a multisection line whose endpoint buses were both in the study system, but for which one or both of the dummy buses adjacent to the two endpoint buses were not in the study system.
  - The multisection line was not in the monitored element list.
- Activity INLF could crash if switched shunts were contained in the working case and a solution with switched shunts locked was attempted.
- In activity OUTS, incorrect circuit identifiers were sometimes printed when the multisection line reporting option was enabled and an out-of-service multisection line was being reported.
- In the one-line diagram drawing functions:
  - Machine status switching (i.e., the SWTCH (S) menu command) in activities DRAW, GDIF, and SCGR failed to change machine status both on the drawing and in the working case.
  - In activities GDIF and SCGR, a machine whose drawing coordinate data record specified its machine identifier (rather than a blank for plant totals) was not annotated.
  - In activity DRED, repeated moves of the same network element sometimes failed for all but the first move.
  - When activity DRED was initiated in windows mode with the accept option enabled (e.g., DRED,AC), network elements that were added to the diagram and that did not exist in the working case were added to the working case.
  - When activity DRED was being operated in accept mode (e.g., DRED,AC) and a bus was being added to the diagram, an incorrect `BUS NAME/NUMBER TABLE OVERFLOW` condition could be detected and cause PSS®E to crash.
- In the optimal power flow solution function:
  - A type one bus connected to a type three bus through a zero impedance line was sometimes handled incorrectly.
  - dc lines that were not numbered sequentially were not properly recognized.
  - When the working case contained type four buses, the branch reactance, branch flow, and generator reserve models behaved incorrectly.
- For an in-line fault at other than the line end position on a branch involved in zero sequence mutual couplings, activities SCMU and SCOP could report incorrect zero sequence (and hence phase) currents for branches within the mutual coupling group.
- Activity SCEQ could fail if sequence data was not present in the working case.
- Negative and zero sequence bus shunt data were incorrectly scaled by system base MVA before being displayed in the Bus Sequence Data Editor dialog.
- In activity LLRF, the DF-Pro Rata and DF-Sched-Pro Rata adjustment methods could each produce incorrect results as a function of transaction order and status.

- The PSS®E interface routines INIMAC/NXTMAC available for use in IPLAN programs behaved incorrectly for buses containing machines with two-character machine identifiers.
- In activities DOCU and DYDA, if the simulation setup contained a RELANG model reference in which ICON(I+1) was a numeric quantity rather than a character quantity, PSS®E could terminate abnormally.

The following program errors were corrected in PSS®E-26 point releases as noted:

- Activity DFAX did not accept two-character machine identifiers. (26.2.4)
- Activity SCGR sometimes printed plant totals where a single machine quantity was expected. (26.2.4)
- In revision 26.2 on the PC only, the bus subsystem selector batch command, BAT_BSYS, did not work correctly when the numbers input option was in effect. (26.2.1)
- Newton solutions could crash if a transformer connected to a type three bus is adjusted by the automatic tap adjustment feature. (26.2)
- Activity ASCC could crash when the following conditions were simultaneously met: line-to-ground faults were being calculated; line-end faults were enabled; a branch being subjected to a line-end fault is involved in zero sequence mutual couplings; and the zero sequence network was more dense than the positive sequence network. (26.2)
- If the Dynamics Data Input File presented to activity DYRE contained multiple references to any of the new subsystem load relay models, activity DYRE or subsequent executions of activity RTRN could crash. (26.2)
- Activity DYRE did not properly convert CMOTOR single-cage representations to the CIM5BL model. (26.2)
- In OPF, an incorrect sign for the susceptive component of admittance load was used. (26.2)

1.16 PSS®E-25.0

1.16.1 General

At PSS®E-25, the FORTRAN 90 programming language is used. Some of the new language features in FORTRAN 90 allow PSS®E to be supplied such that its dimensional capacity may be specified at program start-up rather than at program installation. See Section 3.3 Environment of the *PSS®E Program Operation Manual* for details.

An ownership attribute has been introduced for buses, loads, machines, and branches. While this has an impact on the Power Flow Raw Data File, the format changes involve additional data items at the end of the bus, load, machine, and branch records, and a new data category at the end of the file. Simply adding a record containing a zero to the end of a PSS®E-24 Raw Data File allows it to be read by PSS®E-25 with default ownership data assigned.

PSS®E-25 requires that any Distribution Factor Data File which it reads must have been created by activity DFAX from PSS®E-25.

The optimal power flow program is no longer supplied as an auxiliary program. It has been brought into PSS®E as a set of activities and data editors. Old OPF specs files may be converted into new Optimal Power Flow Raw Data Files and PSS®E Response Files by the auxiliary program CNVOPF. See *PSS®E Program Operation Manual,* Chapter 14.

With the exceptions of the files noted above, there is complete compatibility between PSS®E-24 and PSS®E-25 at the data input file level. That is, any other binary or source data file which could be successfully accessed by PSS®E-24 should also be able to be read by PSS®E-25.

Dynamic simulation Snapshot Files from PSS®E-20 through PSS®E-24 can be read by PSS®E-25; the connection routines CONEC and CONET and user-written models may require minor modifications (see below). To access simulation setups from PSS®E-19 or earlier, see the PSS®E-20 update notes below. While a mid-run Snapshot File written by PSS®E-22 or earlier may be accessed with activity RSTR of PSS®E-25, it may not be used for the purpose of continuing the interrupted run; the entire simulation must be executed.

The majority of PSS®E activities are identical in dialog to PSS®E-24. However, activity CNTB may now be used in either a reporting mode or a data changing mode, and it may have its processing restricted to a subsystem of the working case. These new features have resulted in dialog changes. In addition, there are dialog changes in generating the spreadsheet reports produced by activity ALOC.

1.16.2 CONEC, CONET, and User Models

The permissible length of machine identifiers has been increased from one to two characters. That, along with the migration to FORTRAN 90 (see above), requires that minor changes be made to user's connection routines (CONEC and CONET) and to any user-written models. The following changes should be made:

1. The $INSERT statements referring to insert files supplied with PSS®E should be commented out or deleted, and replaced by the statement:

   ```
   $INSERT COMON4
   ```

   This statement must be the first noncomment statement following the SUBROUTINE statement.

2. Provision should be made for two-character machine identifiers. Local variables into which machine identifiers are to be placed should be declared CHARACTER*2. In user-written plant-related models, the formatting of output for activities DOCU and DYDA should be changed to accommodate two-character machine identifiers. Any routine receiving a machine identifier as an argument should declare it in a declaration of the form:

   ```
   CHARACTER*(*) name
   ```

3. The LOADFR(6,LOADS) real array has been removed. Bus loads are contained in the CLODFR(3,LOADS) complex array.

1.16.3 Windows Mode Subsystem Specification

Those PSS®E activities whose processing or reporting may be restricted to a subsystem of the working case have had their operation streamlined. See *PSS®E Program Operation Manual,* GUI Windows.

1.16.4 Toolbar Definitions

The toolbar definition requirements for all activities involving subsystem specification (see above) as well as several other PSS®E activities and other menu bar initiated functions have been changed.

1.16.5 Transmission Pricing and Open Access Activities

In activity REMM, the branch ownership specifications by areas previously read from the Transactions Raw Data File are no longer accepted. When activity ALOC calculates MW-mile impacts, it uses the new owner attribute and the branch ownership designations specified in activity READ (see *PSS®E Program Operation Manual,* Generator Data and Interarea Transfer Data).

1.16.6 Simulation Model Library

The following models have been added to the model library:

- DEGOV1 is a Woodward diesel governor model.
- WEHGOV is a Woodward electronic hydro governor model.
- WESGOV is a Westinghouse digital gas turbine-governor model.
- CDCAB1 is a detailed ABB dc line model with controls specific to the Kontek HVDC line.

1.16.7 Program Corrections

The following program errors have been detected and corrected:

- In activity JOIN, conflicting circuit identifiers would not get resolved correctly when multiple conflicts between a pair of buses existed (e.g., in joining buses I and J, if originally the following branches existed: I to K ckt 1, I to K ckt 2, J to K ckt 1, and J to K ckt 2.
- The direct tap adjustment (LTCs and/or Mvar controlling transformers) of the Newton-based power flow solution activities could get into an infinite loop in trying to assign generator reactive power outputs in the situation in which multiple generator buses are controlling the voltage at the same remote type one bus, and, at some stage in this iterative assignment process, some of these buses are at their QMAXs and others are at their QMINs. Users have encountered this error when several differently sized plants are controlling the voltage at the same bus and their REMPCTs are all set to the default value of 100.
- In activity TLST, the dc controlling transformer portion of the report would sometimes omit a transformer that should have been included in the report.
- In activity DCCC, if an interface was omitted from the overload report because the change in flow from its base case value was less than the user-specified threshold, subsequently listed interfaces had incorrect interface labels listed.
- The simulation model library can now handle six-digit array indices in activity DOCU.

- An initialization error message from the model IEEEG1 would identify the model name as WSIEG1; similarly, an initialization error message from the model WSIEG1 would identify the model name as IEEEG1.

1.17 PSS®E-24.0

1.17.1 General

Provision for executing PSS®E in a line mode only mode is no longer supported; PSS®E always starts up in windows mode. Those users wishing to drive PSS®E in line mode may do so by specifying activity names in the Command Line Input field at the bottom of the activity selector window. Activities initiated in this manner execute in line mode. See *PSS®E Program Operation Manual,* Command Line Interface*.*

With the exception of the Power Flow Raw Data File format and the Drawing Coordinate Data File format (see below), there is complete compatibility between PSS®E-23 and PSS®E-24 at the data input file level. That is, any other binary or source data file which could be successfully accessed by PSS®E-23 should also be able to be read by PSS®E-24.

Dynamic simulation setups from PSS®E-20 through PSS®E-23 may be ported to release PSS®E-24; users need only to recompile their connection subroutines and relink them into the main body of PSS®E. To access simulation setups from PSS®E-19 or earlier, see the PSS®E-20 update notes below. While a mid-run Snapshot File written by PSS®E-22 or earlier may be accessed with activity RSTR of PSS®E-24, it may not be used for the purpose of continuing the interrupted run; the entire simulation must be executed.

The majority of PSS®E activities are identical in dialog to PSS®E-23. However, a few activities have experienced dialog changes. In activity ARNM, transaction identifier conflicts are resolved automatically rather than having the user designate new identifiers. Similarly, in activity JOIN, machine and circuit identifier conflicts are resolved automatically.

The following dialog changes result from the modeling of multiple loads at a bus (see below).

- The dialog for changing bus data in activities CHNG and ALTR has been changed. Load data is handled following changes to the bus’ data in the same manner that machine data is accessible following changes to a bus’ plant data. Note that many dynamic simulation Response Files will therefore require modification.
- In activities READ, RDCH, and TREA the format of the bus data record is changed and the new load data category follows the bus data category (see below).
- Activity SPLT allows the user to designate the treatment (keep at the original bus or move to the new bus) for each individual load at the bus.

1.17.2 Multiple Loads at a Bus

PSS®E-24 provides for multiple loads at a bus, each of which is identified by a two-character load identifier. Each such load has a status flag and its own area and zone assignment. This new capability has affected the dialog of several PSS®E activities (see above), as well as the formats of the Power Flow Raw Data File and the Drawing Coordinate Data File (see below).

Any user-written models which access load data (e.g., load models, load shedding models) must be modified. The indexing of the LOADFR and CLODFR arrays has been changed, and the scalar flag LCONV and the arrays PLOAD and QLOAD have been removed.

1.17.3 Power Flow Raw Data File

The Power Flow Raw Data File format has a new format for its Bus Data record, and a Load Data category between bus and generator data is introduced. Constant current and constant admittance load data may now be specified in the Power Flow Raw Data File.

All PSS®E activities (such as RAWD) which write records in Power Flow Raw Data File form have been appropriately modified. The auxiliary programs COMFOR and WSCFOR have also been modified.

Any old format data files processed by activities READ, RDCH, and TREA of PSS®E-23 which are to be used by PSS®E-24, as well as Power Flow Raw Data Files created by the auxiliary programs PEFORM, PSAP4, and PESQDT, will have to be modified accordingly. The task of converting old Power Raw Data Files to the new format is handled by the auxiliary program CNVRAW (see *Additional Resources for PSS®E*).

1.17.4 Drawing Coordinate Data File

The manner in which loads are specified in the Drawing Coordinate Data File format has been changed (see *PSS®E Program Operation Manual,* Appendix C*,* Two-Terminal dc Transmission Line Record - DC). Any old format data files processed by activities DRAW, DRED, GDIF, and SCGR of PSS®E-23 which are to be used by PSS®E-24 will have to be modified accordingly. The task of converting old Drawing Coordinate Data Files to the new format is handled by the auxiliary program CNVDRW (see *Additional Resources for PSS®E*).

1.17.5 Load Flow Automatic Adjustments

Three new solution parameters, which are used in the automatic adjustment calculations of the power flow solution activities, are introduced (see *PSS®E Program Operation Manual,* Automatic Adjustment Solution Parameters). Their default values may produce different tap ratio adjustments for Voltage Control and DC Line Control than those calculated at PSS®E-23 and earlier.

1.17.6 User Programmed Pause in Dynamic Simulations

Effective at PSS®E-23, the method used to terminate a simulation described in *PSS®E Program Operation Manual,* Section 19.9.4, Run Termination at PSS®E-23 and earlier releases of PSS®E no longer worked. At PSS®E-24, the subroutine UPAUSE may be used in CONEC in mode three or in CONET to force a pause in the simulation and send control to a Response File.

1.17.7 Simulation Model Library

The following models have been added to the model library:

- ESAC6A is the type AC6A excitation system model from IEEE Std. 421.5-1992.
- CSVGN6 is a controlled static var source model.
- CIMTR5 and CIMWSC are induction motor models with rotor flux transients and undervoltage tripping.
- WSHYG2 and WSIEG1 are WECC governor models.

The models CHIGAT, CMFORD, and DCVREF may now be used in extended term simulations (i.e., in activities MSTR and MRUN).

Errors were corrected in the models CIMTR3, CIMTR4, and EXTLD2 (see below).

1.17.8 Program Corrections

The following program errors have been detected and corrected:

- In the optional interface summary report of activity TLTG, the interface label was incorrectly printed on all but the first page of the interface report.
- In the short circuit activities, when the option to model dc line loading was selected and more than one two-terminal dc line was present in the working case, the conversion of the dc line loading to bus load sometimes used incorrect load values.
- In activity DYRE, alarm as an error the same machine specified as both machines in the data record of a two machine model.
- In activity PSAS, if the optional MACHINE id was specified in a PLACE command WITH IDENTIFIER(S), PSAS would output all machines in the plant with same channel identifier instead of just the one specified.
- In activity RUN and MRUN with CRT plotting enabled, plotting would cease after any dc line model auto-trip.
- In activity RWDY, incorrect governor data may have been placed in the Inertia and Governor Response Data File for the following governor models: BBGOV1, IVOGO, TGOV4, WPIDHY, SHAF25, GAST2A, HYGOVM, HYGOVT, TGOV5, and GASTWD.
- In CIMTR3 and CIMTR4, STATE(K+4) was not initialized to -1. when starting the induction machine.
- In EXTLD2, when frequency sensitivity was enabled, the variation due to frequency for the reactive component of constant admittance load was sometimes calculated incorrectly.
- Minor errors were corrected in CHNG, DIFF, ORDR when used by the fault analysis activities to order the zero sequence network, RNFI, PSEB, PSAS, and SHOW.

1.18 PSS®E-23.0

1.18.1 General

At PSS®E-23, the binary input file read by activity BCAS of the linear dynamic analysis program LSYSAN has undergone changes. As a result, a file written by activity ASTR of PSS®E-23 must be used as the input to the LSYSAN activity BCAS. In addition, the source input file read by activity MCAS of LSYSAN has had a change in format; refer to the PSS®E *Program Application Guide*.

Except as noted above, there is complete compatibility between PSS®E-22 and PSS®E-23 at the data input file level. That is, any binary or source data file which could be successfully accessed by PSS®E-22 of PSS®E should also be able to be read by PSS®E-23.

Dynamic simulation setups from PSS®E-20 through PSS®E-22 may be ported to PSS®E-23; users need only to recompile their connection subroutines and relink them into the main body of PSS®E. To access simulation setups from PSS®E-19 or earlier, see the PSS®E-20 update notes below. While a mid-run Snapshot File written by PSS®E-22 or earlier may be accessed with activity RSTR of PSS®E-23, it may not be used for the purpose of continuing the interrupted run; the entire simulation must be executed.

The majority of PSS®E activities are identical in dialog to PSS®E-22. However, two activities have experienced dialog changes. In activity DLST, CRT plot channels may be listed. An additional prompt is issued to allow the user to specify the starting and ending CRT plot channel numbers whose data is to be listed. In activity ALTR under the category of CRT plot channels, the user is instructed to respecify the scales if CMIN is specified greater than or equal to CMAX.

1.18.2 IPLAN's BRNCUR Subroutine

Through PSS®E-22, the IPLAN routine BRNCUR returned branch current expressed as MVA. Now it returns branch current in amps at the *from bus* end if the *from bus* base voltage has been specified; otherwise, per unit current is returned.

1.18.3 CRT Plotting

The character-based CRT plotting of activity RUN, MRUN, ERUN, and GRUN and the X-window based CRT plotting model CHNPLT have been replaced by a graphic CRT based plotting capability. The number of CRT plot channels has been increased from five to six. Refer to *PSS®E Program Operation Manual,* Section 14.11.1, Response Ratio Test and Section 19.7, Running a Simulation.

1.18.4 Stabilizer and Excitation Limiter Model Outputs

At PSS®E-22 and earlier, the outputs of any stabilizer, minimum excitation limiter and maximum excitation limiter models present at a machine were summed into the machine's VOTHSG array element. This in turn was fed into the supplementary signal input location of the excitation system model.

At PSS®E-23, two new arrays, VUEL and VOEL, are introduced. Stabilizer models place (rather than sum) their outputs into VOTHSG, minimum excitation limiter models place their outputs into VUEL and maximum excitation limiter models place their outputs into VOEL.

User-written stabilizer, minimum excitation limiter, and maximum excitation limiter, models must be modified to place (rather than sum) their outputs into VOTHSG, VUEL, and VOEL, respectively. Similarly, user written excitation models, which have normally provided for a single auxiliary input signal, must sum these three array elements for the machines at which they are called.

1.18.5 User-Written Two-Machine Models

The factor used in packing the pair of machine array indices for a two-machine model (e.g., a cross compound governor model) into the MACNUM array has been changed from 10000 to 25000. Such user-written models must be modified accordingly; see *PSS®E Program Operation Manual,* Section 21.6, Model Writing Notes.

1.18.6 Simulation Model Library

The static var system models CSVGN1, CSVGN3, CSVGN4, and CSVGN5 ignore excitation limiter model outputs which were previously summed into VOTHSG (see above).

The temperature control block of the gas turbine-governor models GAST2A and GASTWD has been changed to more accurately model these devices.

The models IEEEST and EXAC2 had minor errors when used in extended term simulations; the models SWSHN1 and DCTC1 had minor errors. See below.

The following models from IEEE Std. 421.5-1992 have been added to the model library: the PSS2A power system stabilizer model PSS2A; the DC1A and DC2A direct current commutator exciter models ESDC1A and ESDC2A (the type DC3A model is identical to the model IEEEX4); the AC1A through AC5A alternator supplied rectifier excitation system models ESAC1A, ESAC2A, ESAC3A, ESAC4A and ESAC5A; the ST1A through ST3A static excitation system models ESST1A, ESST2A and ESST3A.

PTIST3 models newer versions of the PTI microprocessor-based stabilizer.

The following special-purpose models are distributed with PSS®E: CBES, a battery energy storage FACTS model; CSMES a superconducting electromagnetic energy storage FACTS model; CSTATC, a static condenser FACTS model; TWDM01 and TWDM02, a pair of tail water depression hydro governor models; and BEPSS, a transient excitation boosting stabilizer model.

The models IEET1S, TGBP, PAUX3, and CHNPLT have been removed from the model library.

1.18.7 Program Corrections

The following program errors have been detected and corrected:

- In activity ACCC, if a bus contingency event with the DISPATCH option contained an error, remaining contingencies were skipped. In activity ACCC, when a contingency included multiple machine outage contingency events with the DISPATCH option and one of the participating dispatch buses for one of the machine outages is another of the buses with a machine being outaged, the power dispatch was dependent upon the order in which the contingency events were specified.
- In activity MCRE, if an invalid status value was specified, the corresponding record was ignored.
- In activity MOVE, an incorrect *to bus* was printed in the prompt for resolving conflicting circuit identifiers.
- In activity EEQV, when the option to equivalence phase shifters was enabled, a phase shifter between retained buses could get lost.
- When activity OPTN was invoked from the dynamic simulation activity selector, it destroyed part of the linked list pointers for the factored matrix.
- In activity PSAS, when specifying a multisection line in the APPLY LINE FAULT command, the fault was sometimes placed at the *to bus* end of the multisection line instead of at the *from bus* end.
- Activities ESTR,SINGLE and GSTR,SINGLE sometimes attempted to run the response test even if 0 was specified for the bus whose control system models were to be tested.
- Activities ESTR and ERUN omitted the testing of the exciter at the second machine of a two-machine generator model if no exciter was present at the first machine.
- In activity ERUN when calculating the response ratio test, a zero divide could occur with system models which included a CSVGNn model without an excitation system model.
- The model IEEEST had a minor error in extended term simulations when setting STORE(K+3) following a time step change.
- The model EXAC2 had a minor error in the limit handling of VE in extended term.

- The model SWSHN1 was active even if the control mode of the switched shunt was zero (i.e., fixed).
- The model DCTC1 had an incorrect ratio limit check if a transformer impedance correction table was assigned to the transformer.
- Minor errors were corrected in activities DRAW, GEXM, GOUT, and GRPG.

1.19 PSS®E-22.0

1.19.1 General

At PSS®E-22, increased flexibility in the modeling of zero sequence mutual couplings is provided. As a result, the format of the zero sequence mutual impedance data records in the Sequence Data File has been modified. Any Sequence Data Files which contain zero sequence mutual data records in the form required by PSS®E-21 or earlier and which are to be read by activity RESQ of PSS®E-22 or later must be modified. The task of converting old Sequence Data Files to the new format is handled by the new auxiliary program CNVRSQ (see *Additional Resources for PSS®E*).

Added flexibility has been introduced in the use of Response Files (see see *PSS®E Program Operation Manual,* Section 16.12, Running a Response File). While the previous method of using Response Files (i.e., via the IDEV activity command) continues to work in most cases, changes are required in the case where the PSEB or PSAS USE/COPY/IDEV command is used (see *PSS®E Program Operation Manual,* Section 9.4, Net Generation with Load In a Subsystem and Section 16.14, Building a Response File, Power Flow Calculation). The Response File designated in this command must not contain any IDEV activity commands; these must be changed to @INPUT, @CHAIN and @END commands, as appropriate.

Except as noted above, there is complete compatibility between PSS®E-21 and PSS®E-22 at the data input file level. That is, any binary or source data file which could be successfully accessed by PSS®E-21 should also be able to be read by PSS®E-22.

Dynamic simulation setups from PSS®E-20 and PSS®E-21 may be ported to PSS®E-22; users need only to recompile their connection subroutines and relink them into the main body of PSS®E. To access simulation setups from PSS®E-19 or earlier, see the PSS®E-20 update notes below.

Binary files created by PSS®E-22 or later are not able to be accessed by PSS®E-21 or earlier. While this has always been the case with Saved Case and Snapshot Files, at PSS®E-22 this applies to *all* binary files. In particular, note that Channel Output Files created by PSS®E-22 are not able to be read by earlier releases of PSSPLT.

The majority of PSS®E activities are identical in dialog to PSS®E-21. However, a few activities have experienced dialog changes. In activity CNTB, additional dialog is present for buses controlled by one or more load drop compensating transformers. In activity CHNG when changing two-terminal dc line data while under the names input option, if the *from bus* of the ac transformer is entered as zero, the user is no longer required to designate the *to bus* name and the branch circuit identifier. In activity GOUT and GEXM, when specifying a branch from the graphics display while under the names input option, quoted extended bus names must be specified; previously, two 12-character fields were required.

1.19.2 Extended Term Simulations

There is a more robust bus frequency calculation which allows longer time steps with low inertia systems experiencing large speed deviations.

The model MAXEX2 is a new maximum excitation limiter model.

1.19.3 Simulation Model Library

The application of limits in the proportional/integral block of the model EXPIC1 has been modified to better model actual PI controls. This change in modeling is most noticeable when a large error signal is present (e.g., for a fault near the generator terminals).

The model EXST3 had a minor error when used in extended term simulations (see below).

In the simulation model library, the round rotor generator model GENROE uses an exponential (rather than a quadratic) saturation function. The salient pole generator model GENSAE uses an exponential saturation function and models saturation on both axes. The induction generator model CIMTR3 and the induction motor model CIMTR4 are rotor flux transients models which may be used for machine starting simulations. MAXEX2 is a maximum excitation limiter model. LVSHD3 is an undervoltage load shedding relay model. All of these models may be used in both state space and extended term simulations.

The following user-written and special-purpose models are distributed with PSS®E: EMAC1, the AEP Rockport excitation system model; BUDCEZ, the Czech proportional/integral excitation system model; TURCEZ, the Czech governor model; CEEL, the Eel River dc line and auxiliaries model; CEELR2, the Eel River dc line model; RUNBK, the Eel River and Madawaska dc line runback model; and CMDWS2, the Madawaska dc line model.

1.19.4 Program Corrections

The following program errors have been detected and corrected:

- In activities ASCC, SCGR, and RELA, zero sequence shunts were not correctly restored under the flat conditions option; the transformer ground path admittances were included.
- In activity DFAX, the option to SORT MONITORED BRANCH LIST sometimes failed when the multisection line reporting option was enabled.
- In activity ASCC, incorrect identifiers were printed when there were a large number of monitored lines. In the loading table, bad results were printed for the last case reported if the last case calculated failed to converge. In the loading table, MVA loadings were sometimes printed as negative numbers. The solution could have entered an infinite loop when the contingency created a swingless island and phase shift adjustment and/or direct tap adjustment was enabled.
- In activities FNSL and INLF, a minor logic error was detected in the triangularization of the Jacobian. While the correction may change numeric values in the convergence monitor, it should generally have no significant effect on the convergence properties of these power flow solution activities.
- In extended term simulations using activity MRUN, the model EXST3 had a slight error in setting EFD when V_G was at a limit. User-written generator models which were not coordinated call models were not called during the network solution. Other user-written models which were coordinated call models were called at their main entry points rather than their supplementary entry points during the network solution. In the large time step mode, bus frequencies were updated only upon achieving network convergence rather than at each network solution iteration.

- In activity GDIF, sometimes machines which were out-of-service in both cases were displayed with nonzero P and Q differences.
- In activity SQLI and SQEX, mutuals were sometimes not sorted correctly.
- In activity SCAL, motors which were exactly at a real power limit were alarmed as beyond limits.
- In activity PSAS, the SHED LOAD command zeroed the bus shunt as well as the bus load.
- Input to IPLAN programs did not get output to ECHO files when PSS®E was being operated in windows mode.
- Minor errors were corrected in activities DRAW, DRED, GRPG, GRED, GEXM, GOUT, PSEB, PSAS, STRT, ASTR, ESTR, and GSTR.

1.20 PSS®E-21.0

1.20.1 General

At PSS®E-21, area transactions data is included as part of the power flow case. As a result, a new data category has been added to the Power Flow Raw Data File (Interarea Transfer Data). To have PSS®E-21 successfully read a Power Flow Raw Data File which is in the form required by PSS®E-20, the user must add a data record containing a zero to the bottom of the file.

At PSS®E-21, capacity increases and new features in the linearized network analysis activities have resulted in changes to the format of the Distribution Factor Data File built by activity DFAX. Therefore, any of these files created by PSS®E-20 will have to be rebuilt with activity DFAX of PSS®E-21 before being used in PSS®E-21.

The model EXPIC1, of which an undocumented prerelease copy was included with PSS®E-20, is supplied with PSS®E-21 as a fully integrated model. If you are using this model in any of your simulation setups, you must:

1. Modify any Dynamics Data Files which include EXPIC1 model references and are being retained for possible future use so that this model is referenced on EXPIC1 data records rather than on USRMDL data records.
2. Modify those simulation setups so that the new table-driven form of the model is used. The following procedure may be used:
   a. Create a Dynamics Data File containing data records for all of the EXPIC1 references in the dynamics setup. This may be done using an executable copy of either PSS®E-20 or PSS®E-21 into which the CONEC and CONET subroutines of the system model containing the EXPIC1 model references have been linked.
   b. If (a) was performed using PSS®E-20, modify the Dynamics Data File as described in (1) above.
   c. Restore the PSS®E-20 Snapshot File in PSS®E-21 and use activity DYRE,ADD to read the Dynamics Data File constructed above.

Except as noted above, there is complete compatibility between PSS®E-20 and PSS®E-21 at the data input file level. That is, any binary or source data file which could be successfully accessed by PSS®E-20 should also be able to be read by PSS®E-21.

Dynamic simulation setups from PSS®E-20 may be ported to PSS®E-21; except as noted above, users need only to recompile their connection subroutines and relink them into the main body of PSS®E. To access simulation setups from PSS®E-19 or earlier, see the PSS®E-20 update notes below.

The majority of PSS®E activities are identical in dialog to PSS®E-20. However, in activities AREA, ZONE, INTA, INTZ, TIES, TIEZ, SHNT, TLTG, and POLY, the end of page handling is slightly different when output to the terminal is selected. In the auxiliary program LSYSAN, activity EIGP has experienced a dialog change.

1.20.2 Activities GRPG and GRED

The format of GRED Library Files is changed. To utilize GRED Library Files created in PSS®E-20, they must first be converted to the form required by PSS®E-21. The procedure is:

1. Select activity GRED and specify the PSS®E-20 GRED Library File.
2. Select the EXPORT ALL drawings function to output the drawings contained in the Library File specified in (1) to a Graphical Report Definition File.
3. Select the CHANGE current library function to either select an existing PSS®E-21 GRED Library File or create a new one.
4. Select the IMPORT GRPG commands function and specify the file created in (2).

1.20.3 LSYSAN

In addition to several extensions, the linear dynamic analysis program, LSYSAN, has had a change in its eigenvector normalization calculation. An eigenvector is normalized by dividing each of its elements by the element with the largest magnitude. Prior to PSS®E-21, this normalization was performed on only those eigenvectors whose largest element magnitude was greater than one; at PSS®E-21, all eigenvectors are normalized.

1.20.4 Simulation Model Library

As noted above, the model EXPIC1 has been modified.

The model SYSANG has been modified to handle angles with larger magnitudes in finding the minimum and maximum machine angles. This is necessary for long duration simulations with substantial power unbalances.

Model CRANI was modified to recognize frequency sensitivity. Model CHAAUX had a few minor bugs corrected.

The new model DCTC1 models a two-terminal dc line tap changer. The new model EXTLD2 is a load reset model. Both of these models are supplied with the extended term simulation program section.

The new model INTFLW is a user-written interface flow model.

1.20.5 Program Corrections

The following program errors have been detected and corrected:

- In activity INLF, an incorrect island frequency was calculated when an island contained out-of-service machines at type two or three buses and no records for the machines were included in the Inertia and Governor Response Data File.
- In activity MOVE, there was an error in checking for duplicate machine identifiers when moving a machine to a multiple machine plant bus where the identifier conflicted with that of a machine already at the bus other than the first one present in the internal list of machines at the bus.
- In activity DFAX, there was a possible error in interface member directions when a TIES FROM record was included within an INTERFACE block in the Monitored Element Data File. Also, activity DFAX was modified to work correctly in names input mode.
- In activity SPCB there was a possible incorrect error message or crash if the branch being subjected to the unbalance was not being modeled as a transmission line.
- In activity GRED, all reported problems were corrected.
- Activity RWCM, sometimes miscounted the number of loss zones printed on the LOSS ZONES FOLLOWS record.
- Activities RWCM and RWPE were fixed to work correctly when PSS®E is being operated in names output mode.
- The model CHAAUX had a minor bug in limit handling corrected, as well as a number of errors in its error messages.
- The auxiliary program TMLC, in its list data function, would output R, XL, and RC in English units even if metric was selected.
- The auxiliary program COMFOR did not allow three-digit zone numbers.

1.21 PSS®E-20.0

1.21.1 General

At PSS®E-20, the simulation models STAB2 and GAST2 were changed, and as a result they each require different numbers of storage locations in one or more of the general-purpose storage arrays. Their names have been changed to STAB2A and GAST2A, respectively. Old Dynamics Data Files containing references to either of these models must be modified as follows before they can be read by activity DYRE of PSS®E-20:

- STAB2 data records must be changed to STAB2A.
- GAST2 data records must be changed to GAST2A with one additional data item at the end of each such record.

When activity RSTR or SRRS reads a Snapshot File which references either of these models, it gives the user the option of creating a file in the form required by activity DYRE,ADD which will contain the data records required to implement the model name changes. If any GAST2A data records are present, the user should edit this data file to set the additional data item used by this model on each of these records.

Otherwise, there is complete compatibility between PSS®E-19 and PSS®E-20 at the data input file level. That is, any binary or source data file which could be successfully accessed by PSS®E-19 should also be able to be read by PSS®E-20.

New features in activities DOCU and DYDA require that user-written dynamic models be modified to function properly in these activities; refer to *PSS®E Program Operation Manual,* Section 21.6, Model Writing Notes. Dynamic simulation setups from PSS®E-18 and PSS®E-19 may be ported to PSS®E-20; except as noted above, users need only to recompile their connection subroutines and relink them into the main body of PSS®E.

The majority of PSS®E activities are identical in dialog to PSS®E-19. However, additional program options in activities BRCH, OUTS, TLST, DRAW, GRED, OTDF, DCCC, TLTG, POLY, DMPC, DYCH, DOCU, DYDA, and DYRE, as well as in the auxiliary program IMD, have resulted in changes to their dialog. In addition, an additional instruction occurs in activities RSTR or SRRS if any STAB2 or GAST2 models are encountered when accessing an old Snapshot File (see above).

A new activity, DFAX, is included which builds a Distribution Factor Data File, which in turn is required by activities OTDF, DCCC, TLTG, and POLY. See *PSS®E Program Operation Manual,* Section 8.1, Building the Distribution Factor Data File.

The format of the Relay Output File optionally built by activity ASCC has been changed.

Zone numbers of zero are no longer allowed. In activities READ, TREA, and RDCH, a zone number of zero is handled in the same way as an area number of zero: it is alarmed and set to one. When activity CASE picks up an old Saved Case containing buses assigned to zone zero, a message is printed and such buses are placed in zone 999.

In activity RAWD and EEQV, an additional character is allowed in the RMPCT field of generator data records.

1.21.2 Simulation Model Library

As noted above, the models STAB2 and GAST2 have been replaced by the models STAB2A and GAST2A, respectively.

Models CSVGN1, CSVGN3, CSVGN4, TGOV1, and CSSCS1 have improved modeling of their lead-lag transfer function blocks. The PTIST1 model has had its initialization changed such that the sensors and controls are active at TIME equal to zero seconds. These changes will have no significant on simulation results.

Model DLODSH was modified to allow relay action only when the derivative of frequency is negative.

The new model GASTWD models a Woodward gas turbine-governor. The new model LINRCL is a line reclosing model and the new model LINESW is a line switching model. The new model MTDC03 is a preliminary release of a multiterminal dc line model. The new model CRANI is a series reactor FACTS model.

1.21.3 Program Corrections

The following program errors have been detected and corrected:

- In changing multiterminal dc line converter types (i.e., between inverter and rectifier, or the converter designated as the voltage controlling converter), activity CHNG failed to update an internal array indicating the converter type. In subsequent load flow solution attempts, the multiterminal dc line might block or fail to converge.
- In activity PURG, plant totals would not be updated if a machine with a status flag of in-service was deleted. In deleting a plant at a bus which was designated as an area slack bus, the area slack bus entries were updated incorrectly.
- In the mutual check of activity DIFF, if the first and second branches of a mutual coupling were interchanged in the two cases, the B factors were not always interchanged before being compared. As a result, mutuals which were identical in the two cases were reported as differing. The counting of lines on a page was incorrect in the multisection line check of activity DIFF.
- Activity RDEQ sometimes lost zero sequence shunts.
- In the SINGLE and DOUBLE line outage automatic contingencies, activities OTDF, DCCC, TLTG, and POLY would treat as contingencies the closing of lines which were outaged in the precontingent case rather than skipping them.
- In the response ratio test, activity ERUN might have crashed if two or more pauses were specified before TIME reached 0.5 sec.
- The model HVDCAU used MW rather than pu power as its input when the input code was specified as two.
- Models TOTA and TOTZ omitted from its totals quantities associated with some buses which were connected to zero impedance lines.
- The auxiliary program COMFOR assumed a system base of 100 in converting bus shunts to MW/Mvar rather than using the value specified on the heading record of the Common Format input file.
- A small number of host-dependent errors were corrected as well as some minor errors in the graphics activities.

1.22 Line Mode and Line Mode Interpreter Compatibility

The historic command line interface to PSS®E (the line mode) has been replaced with a modern, event-driven GUI beginning at PSS®E version 30. There exist many response files, representing many man-hours of development effort that use the line mode language, as well as IPLAN programs that also utilize it via the PUSH set of commands. The Line Mode Interpreter (LMI) has been developed to support these usages that read in sequences of the line mode language and calls the appropriate PSS®E API routine - the same API routines that are called by the PSS®E GUI, This is desirable for recording and translation purposes, consistency of behavior, and quality of maintenance. Given this mode of operation the imitation cannot be perfect. This section attempts to capture and summarize the differences.

1.22.1 General

1. Activities that are not permitted (i.e., optional purchase, activity selector, required data, etc.) will absorb all inputs, and produce errors only afterwards.

2. Many warning or informative messages that would have appeared during the dialog will no longer be displayed, or will be displayed at the end of the dialog. In general, if a message presented information needed to respond to a prompt it was maintained; if it was strictly informational, it was not (although many are later produced by the API).

3. Many data errors that depended on values from the case that could short-circuit the activity dialog will no longer occur (the errors will still occur, but later in the dialog) (see some omitted activity data checks, below). In general, if data values could generate additional prompts, or modify the sequence of prompts, those checks are maintained; if the data values produced errors that simply aborted the activity, they were not (for exceptions, see differences in behavior: by activity, below).

4. Bus subsystems with multiple base kV ranges are not supported (actually, this is a limitation of the entire interface).

5. Activities that output data files will have progress or printer selections directed to the report window instead. The LMI dialog will still absorb printer/copies/etc. inputs, even though those choices will not be presented in the menu.

6. Device selection menus no longer present the with or without page breaks alternative; use lines-per-page to control.

7. Next page dialogs for report output have been removed. It compares to running the old interface with the CRT lines per page (OPTN option 23) set to the maximum.

8. Terminal input of data will not verify any values entered until all data is entered. Some prompts may then be repeated (as progress information).

9. Inputs that could accept certain characters or numeric input will not produce data type errors for other character inputs, but will be treated as zero (e.g., CHNG allows 'Q' for data change lines. Entering, say, 'x' will be treated as zero.)

10. Names input is allowed, but all api's are called with bus numbers (means that if you record your input, you will see bus numbers, not names) (this is true of the entire interface). Quoted strings are allowed for bus names, which is a new feature, but within that string the length of the name portion of the extended name is still fixed.

11. Names input mode would generate extra input lines (i.e., the bus names would always be requested on a separate line from everything else). The interpreter simply accepts bus names instead of bus numbers when in names input mode.

1.22.2 By Activity

Other than the general differences cited in General.

1. MENU, DRED, and GRED will be ignored.

2. ECHO works as always, but this is misleading. What ECHO does and always did was to make a copy of all inputs received from the terminal, or standard input device. In the PSS®E

GUI, the only such inputs are responses to prompts generated from IPLAN INPUT and INPUTLN calls, and the equivalent Python API calls.

3. SIZE and CATA output to the report device, not the progress device.

4. ODEV does not show its menu when redirected.

5. GOUT/GEXM will use line mode dialog for CRT display.

6. There is no support for binary coordinate data files.

7. DRAW options to plot by page (or Cycle Through All Pages option) or by bus are not supported (dialog will be absorbed).

8. All DRAW dialog subsequent to plot, other than device and options selections, are ignored (but absorbed). Line mode commands generated from the diagram are not recognized.

9. DRAW options are ignored, except for CHECK. however, the one-line drawing functions are philosophically different. In DRAW, drawing elements were required to match network elements, unless DRAW was run in ACCEPT mode, in which case the entire drawing was simply considered a picture, with no correspondence to the network case. The new one-line diagram allows for bound and unbound items on the diagram, and the coordinate data file input process attempts to bind what it can, drawing all remaining items as unbound.

10. The SS option is assumed for ALOC.

11. CHNG will not print new (changed data) line.

12. TLTG/SPIL will ask for the study and opposing systems by label rather than by number; also it will always ask for these labels, even if the DFAX file has only 1 or 2 subsystems specified.

13. RDEQ/EQRD/SCEQ will ask whether to 'APPLY TRANSFORMER IMPEDANCE CORRECTION TO ZERO SEQUENCE' if any appropriate transformer exists in case, and prior to the subsystem selection dialog (line mode asked only after the first such transformer was selected for the subsystem).

14. EEQV will ask whether to ’SUPPRESS EQUIVALENCING OF PHASE SHIFTER’ if any appropriate transformer exists in case, and prior to the subsystem selection dialog (line mode asked only after the first such transformer was selected for the subsystem).

15. SPLT presents loads, machines, and branches at a bus in ID order rather than in load order.

16. Block data records in terminal input mode will always generate prompts.

17. STRT always asks for an OUTPUT file, and skips asking for a snapshot file if errors are returned from the STRT API,

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Chapter 2

OPF Release History

2.1 Release 32

A description of updates to optimal power flow activities for PSS®E version 32 may be found in Section 1.7, Optimal Power Flow.

2.2 Release 31

2.2.1 Changes

The following changes have been made to the PSS®E OPF at release 31:

- The switched shunt error message is no longer output for voltage band controlled switched shunts that were changed from setpoint to continuous mode following an OPF solution.
- Error numbers returned from API calls to PURGE_OPF_LNCEQN_TRAN and PURGE_OPF_LNCEQN_BRFLOW have been reordered.

2.2.2 New Features

The following new features have been introduced into the PSS®E OPF module at release 31:

- OPF adjustable bus shunt identifiers have been increased to two characters in length to correspond to the new fixed shunt records in the loadflow.
- The OPF Adjustable Bus Shunt records interface with the new Multiple Fixed Shunt records in the loadflow data.
- Multiple Fixed Shunt records within the loadflow data network that have the same bus number and shunt ID as an OPF Adjustable Bus Shunt record will automatically be updated with the Var values of the OPF Adjustable Bus Shunt record following an OPF solution.
- If a corresponding Fixed Bus Shunt does not exist within the loadflow data, then a new Fixed Bus Shunt with the same bus number and shunt ID as the OPF Adjustable Bus Shunt will be added to the loadflow data with the B-shunt MVar value assigned to the Var value from the corresponding OPF Adjustable Bus Shunt as determined by the OPF solution.

- The maximum number of allowable adjustable bus shunts represented in a PSS®E OPF working case has been set equal to the maximum number of fixed bus shunts allowed. This value is typically equal to the maximum bus size level at which PSS®E is invoked.
- Bus voltage limits that are adjusted as a result of the OPF Adjust bus voltage limits for feasibility option being enabled are now identified within the OPF output report by an (o) next to the expanded limit value.
- The OPF solution now gracefully exits if an Empty OPF solution space error is encountered due to a single bus system.
- Two new Response file commands have been added for deleting participating branches and three winding transformers from an OPF interface flow constraint: PURGE_OPF_INTFLW_BRN and PURGE_OPF_INTFLW_3WT.
- The PURGE_OPF_PERRSV_GEN Response file command has been added to remove a participating generator from an OPF period reserve constraint.
- Ten new Response file commands have been added for deleting participating variables from and OPF linear constraint equation:

  PURGE_OPF_LNCEQN_VMAG, PURGE_OPF_LNCEQN_VANG, PURGE_OPF_LNCEQN_PGEN, PURGE_OPF_LNCEQN_QGEN, PURGE_OPF_LNCEQN_TRAN, PURGE_OPF_LNCEQN_BRFLOW, PURGE_OPF_LNCEQN_INTFLOW, PURGE_OPF_LNCEQN_ADJVAR, PURGE_OPF_LNCEQN_SWSHUNT, PURGE_OPF_LNCEQN_ADJLOAD.

2.3 Release 30

2.3.1 Changes

The following changes have been made to the PSS®E OPF at release 30:

- The CNVOPF auxiliary program is no longer supplied.
- The INTGAR and REALAR values in the following OPF BAT_ commands have been condensed and/or reordered for easier entry and consistency. Commands within Response files generated with previous releases of the program will need to be updated, or the Response file regenerated.
  - BAT_OPF_ADJBRX_INDV, BAT_OPF_ADJBRX_SUBSYS,
  - BAT_OPF_ADJVAR_INDV, BAT_OPF_ADJVAR_SUBSYS,
  - BAT_APDSP_TBL,
  - BAT_BRFLW_3WT_INDV, BAT_BRFLW_BRN_INDV,
  - BAT_BRFLW_SUBSYS,
  - BAT_BUS_INDV, BAT_BUS_SUBSYS,
  - BAT_GEN_RCAP_INDV, BAT_GEN_RCAP_SUBSYS,
  - BAT_GENDSP_INDV, BAT_GENDSP_SUBSYS,
  - BAT_INTFLW_MAIN

2.3.2 New Features

The following new features have been introduced into the PSS®E OPF module at release 30.1:

- The SOLVED interface routine, for use in IPLAN or Python programs, has been expanded to report on the results of an optimal power flow solution. Valid return values include: (1) Problem seems infeasible, (2) Maximum number of iterations exceeded, (7) Optimal solution found or (9) Solution not attempted.
- The new ITERAT interface routine, for use in IPLAN or Python programs, will return the number of iterations taken after an OPF solution attempt.

The following new features were introduced into the OPF module at release 30 of PSS®E:

- PSS®E OPF data records can now be purged through the OPF Spreadsheet View and OPF Data Table Editor.
- BAT_ purge commands, Python calls and programming API's have been introduced for each PSS®E OPF data record. Refer to Chapter 3 of the *PSS®E API Manual*.
- The maximum number of allowable active power dispatch units represented in a PSS®E OPF working case has been increased to 2000.
- The maximum number of allowable branch flow constraints represented in a PSS®E OPF working case has been increased to 6000.
- Six digit bus numbers (through 999997) and extended bus names are fully recognized.
- Output and solution report formats have been modified to accommodate six digit bus numbers and extended bus names, and to improve readability.
- Voltage source converters (VSCs) are recognized and treated as equivalent load injections.
- The RMPCT values of switched shunts, FACTs devices and VSCs are recognized and processed by the PSS®E OPF.
- Switched shunt MODSW values of 3, 4 and 5 are recognized and handled in the following manner:

  In-service and optimized (not fixed) switched shunts with a MODSW of 3 or 5 introduce further restrictions on the reactive generation or admittance limits of regulated generators or switched shunts (local or remote) during the OPF solution. For switched shunts that are not optimized (fixed) no adjustments are made to the limits. A switched shunt with a MODSW of 4 (controlling reactive power of VSCs) is introduced as a normal OPF switched shunt control. Since VSCs are handled by the OPF as equivalent load injections, no adjustments are made to the VSC limits.

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Chapter 3

IPLAN Release History

3.1 Overview

This section discusses changes to the IPLAN language only. It does not include changes that may be necessary due to changes in PSSE. For example, this will be the only mention of these kinds of problems:

- PUSH commands typically contain PSSE Line Mode commands. Line Mode command sequences can change from one major release of PSSE to another.
- PUSH commands can also contain data for those Line Mode activities that accept terminal input. PSSE data format can change from one major release of PSSE to another.
- PSSE data retrieval commands can return different information after a major release, although this is unusual. One particular case that caused some issues was the change to 12 character bus names at PSSE-30. This affected the values returned by the data retrieval routine NOTONA.

3.2 Release 19

Most existing Release 18 programs should execute under Release 19 unchanged. A new keyword, NEWREPORT, has been introduced into the language. Existing programs which use this keyword as a variable name or a label will have to be modified.

Summary of changes:

- New command NEWREPORT can be used to start a new report in the application GUI
- Nine new application data retrieval subroutines for PSS®E, and several new values returned by old routines (PSS®E-33)

3.2.1 Release 18.2

- One new application data retrieval subroutine for PSS®E and several new values returned by old routines (PSS®E-32)

3.2.2 Release 18.1

- Thirty-four new application data retrieval subroutines for PSS®E and many new values returned by old routines (PSS®E-31)

3.3 Release 18

All existing Release 17 programs should execute under Release 18 unchanged.

- Summary of changes:
- New internal functions ASIZE, IPLANINFS, LENSTR, ROUND
- Application release information available

Two new application data retrieval subroutines for PSS®E, and several new values returned by old routines (PSS®E-30.3)

3.4 Release 18

All existing Release 17 programs should execute under Release 18 unchanged.

Summary of changes:

- New internal functions ASIZE, IPLANINFS, LENSTR, ROUND
- Application release information available
- Two new application data retrieval subroutines for PSS®E, and several new values returned by old routines (PSS®E-30.3)

3.5 Release 17

The stand-alone simulator has been changed at this release. Any data retrieval routine that contained an error code argument will not modify any value other than that error code. Data retrieval routines that contained an error code argument used to always return a 1; routines that access dynamics data will now return a 9, and routines that retrieve next values (e.g., NXTBUS, NXTBRN) will now return a 2. Of those routines that do not contain an error code argument, the only ones that have changed are CHKTRE and ISLAND, which used to return 0 and now return -1, and SOLVED which used to return 0 and now returns 9.

Summary of changes:

- Changes to permit usage with new PSS®E GUI (PSS®E-30).
- Stand-alone simulator no longer has private dummy data retrieval routines (simplifies installation; standardizes return values; permits future usage of real data).
- Maximum number of internal addresses increased (used for control structures – allows larger and more complex programs).
- Five new application data retrieval subroutines for PSS®E, and several new values returned by old routines.

3.6 Release 16

Most programs that performed correctly under Release 15 should continue to perform correctly under Release 16. There have been some inconsistancies in the handling of string constants with trailing blanks. Those inconsistanies have been corrected. How this could affect existing programs is explained below.

A small class of programs will find better performance under the stand-alone simulator. Those are programs that use immediate commands, but do not use program pauses while response files are open.

Automated procedures that include compiling IPLAN programs, and that use source filenames that do not conform to form name.ipl could be affected as the output files from compilation may have slightly different names.

Summary of changes:

- New command, PAUSE WHILE.
- Compiler file naming logic modified to better handle source files with either no extension, or multiple extensions.
- Immediate commands are now executed by stand-alone simulator.
- Program statements may follow comment terminator.
- Several changes made regarding the handling of trailing blanks in string constants and all blank string variables. Inconsistencies had been found in the past.
- Ten new application data retrieval subroutines for PSS®E, and several new values returned by old routines.

3.6.1 Changes in String Expressions

In all cases of strings containing non-blank characters and trailing blanks, those trailing blanks are removed when the value is stored, either in a variable, or as an intermediate value in an expression. In most cases, when a string constant contains trailing blanks, they are used. Prior to Release 16, four string functions did not do this: REPEAT, RIGHT, BUFSTR, and SUBSTR. They have been changed to be consistent. Below are examples of how these have changed. In each example there are a three identical expressions producing different results. In each case, the first expression was executed using Release 15. The second expression has been evaluated exactly as shown using Release 16, and the second expression has been evaluated using Release 16 by using STRING*10 variables containing the values in the expression (under Release 15 there was no difference between these two methods). The result (stored in a STRING*10 variable) is shown in quotes after the symbol ->.

```
repeat('a ')->aaaaaaaaaa
repeat('a ')->a a a a a
repeat('a ')->aaaaaaaaaa

right(' thisone  ',3)->one
right(' thisone  ',3)->e
right(' thisone  ',3)->one

substr(' abca  ','b','  ')-> aca
substr(' abca  ','b','  ')-> aca
substr(' abca  ','b','  ')-> aca

bufstr('a ') X3 ->aaa
bufstr('a ') X3 ->a a a
bufstr('a ') X3 ->aaa
(i.e. execute v=bufstr('a ') 3 times
```

```
bufstr('  ') X3, bufstr('xyz')->   xyz
bufstr('  ') X3, bufstr('xyz')->   xyz
bufstr('  ') X3, bufstr('xyz')->   xyz
(i.e. execute v=bufstr('a ') 3 times, then v=bufstr('xyz') )
```

Additionally, in most cases, an all-blank string variable was treated as a string containing a single blank. The two exceptions were in the function SUBSTR (demonstrated above) and the function LEN. At Release 15 LEN returned 0 for an all-blank string variable. It now returns a 1.

The other two functions affected were SCAN and VERIFY, introduced at Release 15. In this case the change is complicated by actual errors in how they treated trailing blanks in the search string. The following examples follow the same format as above:

```
scan(' abca  ','a ',F)-> 1
scan(' abca  ','a ',F)-> 1
scan(' abca  ','a ',F)-> 2

scan(' abca  ','a ',T)-> 300
scan(' abca  ','a ',T)-> 7
scan(' abca  ','a ',T)-> 5

verify(' abca  ','a',T)-> 4
verify(' abca  ','a',T)-> 7
verify(' abca  ','a',T)-> 4

verify(' abca  ','a ',F)-> 3
verify(' abca  ','a ',F)-> 3
verify(' abca  ','a ',F)-> 1
```

3.7 Release 15

Summary of changes:

- New functions GETDIR, SETDIR, GTWRDL, SCAN, and VERIFY.
- Sixteen new application data retrieval subroutines for PSS®E and several new values returned by old routines.
- File can be opened with a mode of RF.

If files are opened with modes of either 'RF' or 'RWF', then systems that support Fortran Carriage Control will parse the input file differently (see Section 4.4 File Types). Prior to Release 15 the 'F' specifier had no effect on read operations.

All programs that do not open files with modes of either 'RF' or 'RWF' that performed correctly under Release 14, should continue to perform correctly under Release 15 unchanged.

The following example illustrates the change (assuming the program is being run on a Windows® system using the compiler recommended for Release 15 of IPLAN). Consider writing the following to two files, one opened with forms control, and one without:

```
1Line one
 Line two
1Line three
```

The two files would contain the following, including all control characters (see Section 4.4 File Types):

File 1 (with forms control)	File 2 (no forms control)
<FF>Line one<CR>	1Line one<CR>
<LF>Line two<CR>	<LF> Line two<CR>
<FF>Line three<CR>	<LF>1Line three<CR>
<LF>	<LF>

The contents of the file are a continuous set of bytes. The division of that data into apparent records above is simply to facilitate the example and has no physical basis.

Consider this IPLAN program:

```
Program FccExample
String buffer
On eof (1) goto next:
Open ‘File1’ on 1 for ‘RF’
Loop
Readln buffer
While (true)
Next: close(1)
On eof (1) goto done:
Open ‘File2’ on 1 for ‘RF’
Loop
Readln buffer
While (true)
Next: close(1)
End
```

Under Release 14 and Release 15, each read would produce slightly different contents for buffer as follows:

Release 14	Release 15
`<FF>Line one`	`<FF>Line one`
`Line two<CR><FF>Line three`	`<LF>Line two`
`1Line three`	`<FF>Line three`
`1Line one`	`<LF>`
` Line two`	`1Line one`
`1Line three`	`<LF> Line two`
	`<LF>1Line three`
	`<LF>`

Files that are written and read without forms control will be read in, exactly as they were written. Files that are written and read with forms control will have a forms control character in the first position of the buffer. The remainder of the buffer, starting in column two, will be exactly as written (some special care must be taken with the first record of the file, see Section 4.4 File Types).

3.8 Release 14

Output buffers have been expanded from 256 characters to 1024. Programs that depended on output buffers having a default length of 256 characters might produce different looking results. The SET command (see Section 3.26.2 Controlling New Output Buffer Creation) can be used to reset the operational buffer length.

Summary of changes:

- New function FILESEL allows a file selection window to be displayed.
- Maximum length for output buffers expanded to 1024 bytes.
- Type check errors for argument lists display left-to-right.
- Run time error messages can handle source file name references > 132 characters.
- Compiler error checks added for the following: type of reference in INPUTLN, DELETE, REWIND; RETURN in main program; unterminated string literal.
- Operation of JUSTRIGHT function and SET PUSH command corrected.
- Extensive changes to improve efficiency of compiler and simulator.
- New application data retrieval subroutines for PSS®E three-winding transformer data.
- Number of I/O units increased to 15.
- Write allowed to application unit returned by OPENUN.

3.9 Release 13

Summary of changes:

- A running IPLAN program will now recognize an IP interrupt code.

- The SET command has been added to define a line to be PUSHed for certain program termination conditions.
- Strings can be defined up to 300 characters.
- The ECHO function has been defined; when included in an output list to the ASK or ASKX command it will cause the same prompt to be issued also as a PRINT, if those destinations are different.
- Input and output buffers have been expanded to 256 characters.
- The size at which output is forced to a new buffer can be set by the user.
- ON with the GOTO option referencing a label in the main procedure will terminate all procedures.
- Format codes may now be specified for INPUT and READ.
- The TAB function can now be used with INPUT.
- Error messages about unrecognized data now display that data.
- Negative values for TAB function defined.
- Limitations on source line continuations eliminated.
- New application data retrieval subroutines for PSS®E FACTS devices.
- Several other minor errors were corrected.

3.9.1 New Keywords

The new keywords, INTERRUPT and SET, have been introduced into the language. Existing programs that use these keywords as variable names or labels ***will have to be modified***.

3.9.2 GOTO Option of the ON Command

Programs compiled prior to Release 13 containing ON statements using the GOTO option in procedures that reference a label in the main program will not automatically terminate the active procedures. Their behavior will be unchanged from previous releases. If the program is recompiled with the Release 13 compiler, the program will then perform as documented. Refer to the examples in Section 3.20 Condition/Exception Handling. A program compiled prior to Release 13 would produce the output shown for the second example, but for the first example it will produce these three lines:

```
HERE
RIGHT
HERE
```

After recompiling with the Release 13 compiler, the first example will produce the single line, HERE, as shown in Section 3.20 Condition/Exception Handling.

3.9.3 Negative Values for the TAB Function

Although undocumented and unsupported, the TAB function did allow negative values prior to this release. Behavior for output statements is unchanged, and TAB was not allowed on INPUT statements previously. For the READ command, however, negative values for the TAB function would have had no effect.

3.9.4 Expanded Output Buffers

Output buffers have been expanded from 132 characters to 256. Programs that depended on output buffers of 132 characters will produce different looking results. The SET command (see Section 3.26.2 Controlling New Output Buffer Creation) can be used to reset the operational buffer length to 132.

3.10 Release 12

All existing Release 11 programs should execute under Release 12 unchanged.

Summary of changes:

- Fixed limits on number of variables or size of the compiled program have been eliminated.
- Syntax for continuing source code lines has been added.
- PAUSE READ command added to pause program while input is directed to a file.
- OPEN mode may be mixed case.
- Options specified on the command line are now treated as defaults.
- Filenames no longer limited to 132 characters.
- New function, GTERR, added to control error messages from other GTxxxx functions.
- BUFINIT sets return code.
- REPORTX buffer flushed (printed) when any PUSH statement is executed.
- ASKX buffer flushed (printed) when any INPUT statement is executed.
- Expressions in the last argument of a call statement caused compiler errors; this was corrected.
- Declarations following a source code error in a declaration are not recognized.
- Misplaced keywords now give detailed error messages.
- Compiler errors in argument lists now indicate (numerically) the argument in error.
- All I/O errors report filename.
- Errors opening include files now included in listing file.
- New application data retrieval subroutines for PSS®E owner data.
- Several error messages were added or improved.
- Trailing blanks eliminated in listing file.
- Reference section added to documentation.

3.11 Release 11

Summary of changes:

- The CALL statement has been enhanced to recognize the subroutine names USREX1, USREX2, etc., through USREX9, which are intended to be user-defined programs.
- Program sizes have been increased.

- New compiler option -INC will allow tracking of line numbers in INCLUDE files for error reporting.
- Source filenames will be reported in error messages.
- Run-time errors can now report actual source line numbers and filenames.
- New compiler option -SEARCH will allow the specification of up to five directories to be searched for INCLUDE files.
- Programs can now receive arguments (new verb ARGUMENT, and related function ARGPOS).
- Output can now be directed to the report window of windowized applications (new verbs REPORT and REPORTX).
- The PROMPT function has been enhanced by the introduction of two new verbs, ASK and ASKX (the PROMPT function is now considered obsolete).
- Labels are now local to the procedure where they are defined.
- The number of internally generated labels has been reduced (relaxes some restrictions on program complexity).
- Compiler statistics (-STAT option) were greatly enhanced.
- If source file is not found, request for filename prompt is repeated.
- Several application data retrieval subroutines were added (see Appendix A).
- The RND function has been completely rewritten.
- Two new string expression operations have been defined: 1) to remove from the right, and, 2) to repeat strings.
- Functions to left and right justify string have been added.
- A function to return the version and release number of the compiler and simulator have been added.
- Several error messages were added or improved.
- Detection of improper code structures has been improved.
- Appendix A has been reorganized and enhanced.

3.11.1 New Keywords

The new keywords, ARGUMENT, ASK, ASKX, REPORT, REPORTX, have been introduced into the language. Existing programs which use these keywords as variable names or labels ***will have to be modified***.

3.11.2 String Expression Operators

The expression operators `*` and `**` have been redefined for strings. Existing programs which used these operators in string expressions ***will have to be modified***.

3.11.3 Syntax Analysis

Verification of program syntax has been tightened in many cases. This may cause existing programs which had compiled successfully to fail. These programs should be modified. These errors expose latent or potential program errors. For example:

```
PROGRAM A
INTEGER B(2),I
LOOP I=1,2
B(I) = I
ENDLOOP
PRINT B
END
```

This program, which used to print the number 1, will now fail to compile.

3.12 Release 10

Summary of changes:

- Routines have been added to get (FNDFIL) and return (FNDNXT) a list of files.
- The character set for IPLAN statements and variable names has been extended to include lowercase letters.
- Any character may be used in comments and string variables, even nondisplay values.
- Variable names and labels may now be up to 80 characters long. IPLAN can compile and/or run multiple files in one execution by using the new -LOOP option.
- Filenames as long as 132 characters may now be used.
- The immediate commands @INPUT and @CHAIN will no longer push the first line of the file to the application, but will return control immediately to IPLAN after the file has been opened.
- When invoked by an application (not stand-alone) not using a GUI, the current prompts will be displayed when a PUSH string is echoed to the terminal.
- Several minor enhancements and corrections were made to error messages and to general I/O to increase GUI compatibility.

3.12.1 Use of @INPUT and @CHAIN:

In Release 9, when @INPUT or @CHAIN was 'PUSH'd, the first line of that file was also automatically 'PUSH'd. This was an error and has been corrected, but some existing programs could be affected.

3.13 Release 9

Summary of changes:

- New intrinsic functions have been added to produce and control prompts. This has an impact on the existing PRINTX command.
- A new OPTION parameter, PRINTX, has been added to provide some backward compatibility for the PRINTX command.
- IPLAN may now PUSH immediate, i.e., @, commands.
- IPLAN input requests will recognize redirection (e.g., the application is operating in a mode where terminal I/O has been redirected to a file, IPLAN will also read (commands INPUT and INPUTLN) from that file).

- IPLAN forms can now determine its output format (e.g., GUI, X, ASCII, GDDM). In addition, an optional selection menu is available.
- IPLAN forms window may be kept on screen when a form is closed and rebuilt.
- IPLAN graphics device selection will now use the same menu as the application.
- SYMBOL (IPLAN graphics) now has access to defined symbols above 128.
- Detection of too many variables by compiler has been reduced in severity to a warning. In addition, the -STATS option will be turned on automatically in this case.
- The compiler will issue warning for unrecognized command line options.
- PUSH and PRINT now use independent I/O buffers.
- The PRINTX buffer is printed at program termination.
- String operators for upcase and lowcase have been corrected.
- Several enhancements to error messages were added.
- Several enhancements to application data retrieval functions were added.
- Several inconsistencies in I/O operation were corrected.
- Several minor errors in GUI interaction were corrected.

3.13.1 New Keywords

A new keyword, NOPRINTX, has been introduced into the language. Existing programs which use this keyword as a variable name or a label ***will have to be modified***.

3.13.2 Prompts

Prior to Release 8 of IPLAN the concept of prompts, as different from simply printing information or questions did not exist.

Starting at Release 8 prompts issued by the application, which may or may not have been echoed to the progress area of GUI applications, are not displayed until terminal input is requested. If control is returned to the application, pending prompts are cleared.

Starting at Release 9, control of prompts was added to IPLAN. PRINTX, which previously had acted much like prompts do now, underwent a behavior change. It now strictly augments the PRINT command. However, the OPTION PRINTX command was added to allow programs using that option to behave largely as before. The following, using the application PSS®E, without a GUI, illustrates the changes. All lowercase dialog was entered at the terminal. The information to the right, headed by a left arrow, are comments and sample IPLAN code.

```
               POWER TECHNOLOGIES INCORPORATED

        12000 BUS POWER SYSTEM SIMULATOR--PSS®E-20.1

 INITIATED AT LOAD FLOW ENTRY POINT ON FRI JAN 14, 1994  10:42

 ACTIVITY? exec prx

 ACTIVITY?  SOME INFO
 A QUESTIONstuff
 ANOTHER QUESTIONstuff
what
 INVALID ACTIVITY--PLEASE TRY AGAIN

 ACTIVITY? stop
```

This program (on right) run under PSS®E-20 (IPLAN 7). Lowercase entered at the terminal.

```
PROGRAM PRX
STRNG A
PRINT 'SOME INFO'
PRINTX 'A QUESTION'
INPUTLN A
PRINTX 'ANOTHER QUESTION'
INPUTLN A
END
```

```
---------------------------------------------------------------
               POWER TECHNOLOGIES INCORPORATED

        12000 BUS POWER SYSTEM SIMULATOR--PSS®E-21.1

 INITIATED AT LOAD FLOW ENTRY POINT ON FRI JAN 14, 1994  10:46

 ACTIVITY? exec prx
 SOME INFO

 ACTIVITY? A QUESTION stuff
 ANOTHER QUESTION stuff
what
 INVALID ACTIVITY--PLEASE TRY AGAIN

 ACTIVITY? stop
```

Same program run under PSS®E-21 (IPLAN 8).

```
--------------------------------------------------------------
               POWER TECHNOLOGIES INCORPORATED

         12000 BUS POWER SYSTEM SIMULATOR--PSS®E-22.0

 INITIATED AT LOAD FLOW ENTRY POINT ON FRI JAN 14, 1994  11:09

 ACTIVITY? exec prx
 SOME INFO
 A QUESTION

 ACTIVITY? stuff
 ANOTHER QUESTION
 ? stuff
what
 INVALID ACTIVITY--PLEASE TRY AGAIN

 ACTIVITY? exec prx9
 SOME INFO
 A QUESTION

 ACTIVITY? stuff
ANOTHER QUESTION stuff
what
 INVALID ACTIVITY--PLEASE TRY AGAIN

 ACTIVITY? exec prxnew
 SOME INFO
A QUESTION stuff
ANOTHER QUESTION stuff

 ACTIVITY? what
 INVALID ACTIVITY--PLEASE TRY AGAIN

 ACTIVITY? stop
```

Same program run under PSS®E-22 (IPLAN 9).

Original program modified by addition of OPTION PRINTX statement.

Original program modified using new features for controlling prompts (as shown on right).

```
PROGRAM PRXNEW
INTEGER I
STRNG A,ACT
PRINT 'SOME INFO'
ACT = PROMPTR(2)
I=PROMPTC
I=PROMPT('AQUESTION',1)
INPUTLN A
I=PROMPT('ANOTHER QUESTION',1)
INPUTLN A
I=PROMPT(' ',0)
I=PROMPT(ACT,1)
END
```

Programs written before Release 9 of IPLAN may also see the following behavior changes:

- Unformatted REALs written to a file will display up to seven significant figures.
- Negative values supplied to the TAB function will be defined to not overwrite data in the buffer. Previous behavior was inconsistent.
- The PRINTX buffer is preserved after execution of a PUSH statement.
- String formats less than the operational length of the string will display a string of the specified length, the left-most portion if positive, the right-most if negative.

At Release 9 of IPLAN, the ability to PUSH immediate commands such as “@” was added including @INPUT and @CHAIN for those applications for which they were enabled. However, the first line from the file was immediately read and returned to the application. After Release 9, the file is opened and control returns immediately to IPLAN.

SIEMENS

Chapter 4

PSSPLT Release History

4.1 PSS®E Compatibility

At PSS®E-27, the names of the old line relay models called from subroutine CONET are no longer recognized in activity RELY. In the relay characteristic data file, records for such models must be changed to contain the new model name (see *PSSPLT Program Manual*, Section 4.17, RELY; see also Section , Table-Driven Models).

There are no functional differences between PSS®E-25 and PSS®E-26.

There are no functional differences between PSS®E-24 and PSS®E-25.

For PSS®E-24, the dialog for modal analysis PLOT changed somewhat, thus making PSS®E-23 IDEV files invalid only if they contain modal analysis dialog (see *PSSPLT Program Manual*, Section 4.13 PLOT).

For PSS®E-23, there are no dialog changes that would invalidate prior-release IDEV files.

For PSS®E-22, the dialog associated with activity SLCT was changed (see *PSSPLT Program Manual*, Section 4.12 SLCT). However, prior-release IDEV files are still valid. The interactive option for activity PLOT contains four menu time-based commands (see *PSSPLT Program Manual*, Section 4.13 PLOT).

4.2 Prior Versions of PSSPLT

Version 20.0 of PSSPLT is fully compatible with PSSPLT Version 19.0.

For PSSPLT Version 19.0, the dialog for activity POPT was changed (see *PSSPLT Program Manual*, Section 4.2 POPT). All option numbers have changed. Option 22 has been added and Option 5 now allows up to 31 time intervals on a plot. The existing PSSPLT.OPT option files are compatible with Version 19.0 of PSSPLT.

The dialog for activity RANG, Option 8, was changed. A channel range and identifier mask are prompted for which affects response files (see *PSSPLT Program Manual*, Section 4.3 RANG).

The dialog for activity CHID was changed. The user is now asked if he wants to change the channel identifier of the channel number chosen. Activity CHID repeatedly asks for a channel number until the user is finished changing channel identifiers (see *PSSPLT Program Manual*, Section 4.20 CHID).

The dialog for activity PTYP,FFT was changed. The FFT menu allows the user to choose what functions to use when plotting. User response files will need to be updated (see *PSSPLT Program Manual*, Section 4.9 PTYP).

The suffix RA has been removed from activity PLID. Instead, the option is invoked via dialog within the activity (see *PSSPLT Program Manual*, Section 4.14 PLID).

For Version 17.0, the dialog for activities LFTI and SUBT were changed to allow a blank line for the title line (see *PSSPLT Program Manual*, Section 4.5 LFTI and Section 4.6 SUBT). Activity RAWC's dialog was changed to prompt the users to output either all or selected channels to the source output file (see *PSSPLT Program Manual*, Section 4.21 RAWC).

For Version 16.0, the dialog for activity FUNC was changed (see *PSSPLT Program Manual*, Section 4.11 FUNC). A number of new functions has been added and the user must first choose what function to plot. Option 2, terminal speed, in activity POPT has been deleted and all remaining option numbers were decreased by one (see *PSSPLT Program Manual*, Section 4.2 POPT). All options that have only two settings were changed to toggle the settings using a <CR>. The existing PSSPLT.OPT option files are compatible with Version 16.0.

For Version 15.0, the dialog for Options 14 and 16 in activity POPT were changed to toggle the settings. This was done so that the dialog is consistent with other options that have only two choices. Activity OPTN has been removed since all functions are handled by Activity POPT. A new parameter to identify the relay type as MHO, impedance, or reactance has been added as the first DISTR1 relay parameter.

PSSPLT Version 14.0 is upward compatible with the previous releases of PSSPLT with the exception of activity FUNC. Activity FUNC allows the user to define an arithmetic function using up to six channels rather than choosing function parameters for a predefined function (see *PSSPLT Program Manual*, Section 4.11 FUNC). PSSPLT response files have to be updated to include the input of a function, not the input of parameters.

PSSPLT Version 13.0 is upward compatible with the initial release of PSSPLT (Version 12.0) with the exception of the GRID option (Option 11) in activity POPT (see *PSSPLT Program Manual*, Section 4.2 POPT). The GRID option has been enhanced to include four types of grids (including none) rather than the previous on/off switch. This requires an extra response when changing the grid option. A response of 1 to the second prompt will provide the same GRIDS as the initial release. PSSPLT response files may need to be updated to include the additional response.

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Chapter 5

Saved Case Data Extraction Subroutine Release History

5.1 General

Release 19.0 of the Saved Case Data Extraction Subroutines can read a PSS®E saved case produced by PSS®E-16 through PSS®E-32. Programs written using earlier releases of these subroutines can use any Release 19.0 subroutine except as noted below.

5.1.1 Converting from Prior Releases

Each release of the Case Data Extraction Subroutines may include changes in how the subroutines are to be called. The following summarizes those changes by listing, for each release, the conversions necessary for programs using the prior release to call the current versions of subroutines:

5.2 Release 19

PSSSIZ

The argument list to PSSSIZ has been modified by the addition of the values NINDMC and NGNECL.

PSSMSC

The argument list to PSSMSC has been modified by the addition of the value PSSVER.

PSSBUS

The argument list to PSSBUS has been modified by the addition of the arrays NMAXV, NMINV, EMAXV and EMINV.

PSSLOD

The argument list to PSSLOD has been modified by the addition of the array LDINTR.

PSSTRN

The argument list to PSSTRN has been modified by the addition of the array VECGRP2.

PSS3WT

The argument list to PSS3WT has been modified by the addition of the array VECGRP3.

PSSIND

This is a new routine.

5.3 Release 18

PSSSIZ

The argument list to PSSSIZ has been modified by the addition of the values NAREAS, NZONES, and NOWNRS.

PSSLOD

The argument list to PSSLOD has been modified by the addition of the array LDSCALE.

PSSWSH

The argument list to PSSWSH has been modified by the addition of the arrays ADJM and STAT.

PSSAIN

The argument list to PSSAIN has been modified by the addition of the array ARNUM. Logic to process these arrays will need to be modified. In previous versions these arrays were indexed, i.e. areas were identified by their number, which was the position in the arrays.

PSSZNM

The argument list to PSSZNM has been modified by the addition of the array ZONUM. Logic to process these arrays will need to be modified. In previous versions these arrays were indexed, i.e. zones were identified by their number, which was the position in the arrays.array

PSSOWN

The argument list to PSSOWN has been modified by the addition of the array OWNUM. Logic to process these arrays will need to be modified. In previous versions these arrays were indexed, i.e. owners were identified by their number, which was the position in the arrays.

PSSTRN

The argument list to PSSTRN has been modified by the addition of the array ANGW.

5.4 Release 17

PSSSIZ

The argument list to PSSSIZ has been modified by the addition of the values NBUSHN and NWNDMC.

PSSMSC

The argument list to PSSMSC has been modified by the addition of the values XFRRAT, NXFRAT, and BASFRQ.

PSSBUS

The argument list to PSSBUS has been modified by the removal of the array SHUNT. If cases older than PSS®™E-20 are used, zone numbers of zero are reset to 9999. In prior releases of USRCAS they were reset to 999.

PSSFSH

This is a new routine. The bus shunt data from PSSBUS is moved to this routine with some additional data.

PSSGEN

The argument list to PSSGEN has been modified by the addition of the arrays WMOD and WPF.

PSS2DC

The argument list to PSS2DC has been modified by the addition of the array NAME. Logic to process these arrays will need to be modified. In previous versions these arrays were indexed, i.e. lines were identified by their number, which was the position in the arrays.

PSSMDC

The argument list to PSSMDC has been modified by the addition of the array NAME.Logic to process these arrays will need to be modified. In previous versions these arrays were indexed, i.e. lines were identified by their number, which was the position in the arrays.

PSSFCT

The argument list to PSSFCT has been modified by the addition of the arrays NAME, REMOT and MNAME.Logic to process these arrays will need to be modified. In previous versions these arrays were indexed, i.e. devices were identified by their number, which was the position in the arrays.

5.5 Release 16

PSSBUS

The character length of the array NAME has been increased to 12 from 8.

PSSTRN

The character length of the array TRNAME has been increased to 12 from 8.

PSS3WT

The character length of the array TRNAME has been increased to 12 from 8.

PSSAIN

The character length of the array ARNAME has been increased to 12 from 8.

PSSVSN

The character length of the array VNAME has been increased to 12 from 8.

PSSWSH

The argument list has been modified by the addition of the array RMPCT.

PSSMDC

The character length of the array DCNAME has been increased to 12 from 8.

PSSZNM

The character length of the array ZONAME has been increased to 12 from 8.

PSSOWN

The character length of the array OWNAME has been increased to 12 from 8.

PSSFCT

The argument list has been modified by the addition of the array REMPCT.

5.6 Release 15

PSSSIZ

The argument list to PSSSIZ has been modified by the addition of the value NVSC.

PSSVSC

This is a new routine.

PSSWSH

The argument list to PSSWSH has been modified by the addition of the array RMINDX.

PSSFCT

The argument list to PSSFCT has been modified by the addition of the array VSREF.

5.7 Release 14

PSSFCT

The argument list to PSSFCT has been modified by the addition of six values, PBRDG,QSHNT,PSEND,QSEND,PTERM, and QTERM, that return the complex power demand at the sending and terminal buses.

5.8 Release 13

PSSSIZ

The argument list to PSSSIZ has been modified by the addition of the values N3WNDT, ADJLOD, and ADJBRN.

PSSMSC

The argument list to PSSMSC has been modified by the addition of the value HIBUS.

PSSBRN

The argument list to PSSBRN has been modified by the removal of the arrays RATIO and ANGLE.

PSSTRN

The argument list to PSSTRN has been modified by the addition of the following arrays: WIND1, WIND2, NOMV1, NOMV2, ANG1, SBASE1, TRNAME, and INDX3W. In addition, the meaning of the array STEP has been modified, and is now referred to as NTAPS in the documentation to emphasize this change.

PSSFCT

The argument list to PSSFCT has been modified by the addition of the arrays SET1 and SET2.

PSS3WT

This is a new routine.

PSS3IX

This is a new routine.

PSSABX

This is a new routine.

PSSALD

This is a new routine.

5.9 Release 12

PSSSIZ

The argument list to PSSSIZ has been modified by the addition of the values NFACTS and MAXFCT.

PSS2DC

The argument list to PSS2DC has been modified by the addition of the arrays CIMTX, CACC, and XCAP.

PSSFCT

This is a new routine.

5.10 Release 11

PSSSIZ

The argument list to PSSSIZ has been modified by the addition of the values MAXARE, MAXZNM, MAXTIC, MAX2DC, MAXOWN.

PSSBUS

The argument list to PSSBUS has been modified by the addition of the array OWNER.

PSSLOD

The argument list to PSSLOD has been modified by the addition of the array OWNER.

PSSGEN

The argument list to PSSGEN has been modified by the addition of the arrays OWNER AND OWNPCT. The element of array IDE, the generator ID's, are now two characters each, increased from one each. Also, return codes 3 and 4 have been defined.

PSSBRN

The argument list to PSSBRN has been modified by the addition of the arrays OWNER and OWNPCT. Also, return codes 3 and 4 have been defined.

PSSAIN

The dimensions of the arguments are now determined by the MAXARE value returned by PSSSIZ.

PSS2DC

The ordering of the dimensions of the two-dimensional array arguments has been reversed, and the dimension corresponding the number of lines is no longer fixed, but is determined by the MAX2DC value returned by PSSSIZ. Also, return codes 3 and 4 have been defined.

PSSMDC

The argument list to PSSMDC has been modified by the addition of the array OWNER, and the dimension corresponding to the number of lines is no longer fixed, but is determined by the MAXMDC value returned by PSSSIZ.

PSSTIC

The ordering of the dimensions of the two-dimensional array arguments has been reversed, and the dimension corresponding to the number of tables is no longer fixed, but is determined by the MAXTIC value returned by PSSSIZ.

PSSZNM

The dimensions of the arguments are now determined by the MAXZNM value returned by PSSSIZ.

PSSOWN

This a new routine.

5.11 Release 10

PSSAIN

The dimensions of the arguments have been increased. Calling programs must use arrays declared with the new dimensions.

PSS2DC

The dimensions of the arguments have been increased. Calling programs must use arrays declared with the new dimensions.

PSSTIC

The dimensions of the arguments have been increased. Calling programs must use arrays declared with the new dimensions.

PSSREV

This is a new routine.

5.12 Release 9

PSSSIZ

The argument list to PSSSIZ has been modified by the addition of the value NLOAD.

PSSBUS

The argument list to PSSBUS has been modified by the removal of the arrays PLOAD and QLOAD.

PSSCNV

This routine has been removed.

PSSLOD

This is a new routine.

PSSBRN

The argument list to this routine has been modified by the addition of the array LEN.

5.13 Release 8

Release 8 requires no conversion of existing programs.

5.14 Release 7

PSSTRN

The argument list to PSSTRN has been modified by the addition of the array XFR-CMP.

5.15 Release 6

PSSSIZ

The argument list to PSSSIZ has been modified by the addition of the value NTRNAC.

PSSTIC

The number of allowed transformer impedance correction tables has been increased from 9 to 16. Calling programs must use arrays declared with the new dimensions.

PSSATR

This is a new routine.

5.16 Release 5

PSSMDC

All of the two-dimensional arguments to PSSMDC have had their first dimension increased. Calling programs must use arrays declared with the new dimensions.

PSSMSL

The argument list to PSSMSL has been modified by the addition of the array METBUS.

5.17 Release 4

PSSSIZ

The argument list to PSSSIZ has been modified by the addition of the values NMSLIN, NSECTN.

PSSMDC

The argument list to PSSMDC has been modified by the addition of the arrays VCONVN, CNVCOD, IDC2, RGRND, and LDC.

PSSMSL

This is a new routine.

PSSZNM

This is a new routine.

5.18 Release 3

Release 3 could not read PSS®E-16 or PSS®E-17 saved cases. Logic written to deal with this limitation can be removed.

PSSMSC

The argument list to PSSMSC has been modified by the addition of the value LCONG.

PSS2DC

The argument list to PSS2DC has been modified by the addition of the arrays PAC, QAC, DCVMIN, IC, IFR, ITO, and ID.

PSSTIC

The number of allowed transformer impedance correction tables has been increased from 5 to 9. Calling programs must use arrays declared with the new dimensions.

PSSMDC

The argument list to PSSMDC has been modified by the addition of the array PAC and QAC.

5.19 Release 2

Release 2 could not read a PSS®E-16 saved case. Logic written to deal with this limitation can be removed.

PSSTRN

The argument list to PSSTRN has been modified by the addition of the array CNTL.

5.20 Release 1

Release 1 was the first release of these routines and could read PSS®E-16 saved cases only.

5.21 Reading Older Saved Cases

This section is for issues other than dimensional changes, additional data items, or added subroutines. In general, using the current versions of any of these routines will return the same values as in PSS®E when an older case is read. Exceptions, programming considerations, or data values that would be different than in prior versions of these routines are described below.

5.21.1 Prior to PSS®E-27

Transformer representation in PSS®E changed in PSS®E-27, although the internal representation did not change as much as the external representation (raw data format). There are no programming considerations other than those apparent from the changes described above. The following is a brief summary of those changes.

The RATIO and ANGLE arrays were removed from PSSBRN, and the STEP array was removed from PSSTRN. The values that had been returned in arrays RATIO and ANGLE can be retrieved from arrays WINDRP and PSANGL, respectively. The STEP arrays can be calculated from the RMIN, RMAX, and NTAPS arrays returned by PSSTRN as STEP = (RMAX-RMIN)/(NTAP-1).

In cases prior to PSS®E-27 is was possible for the arrays B, GBJ, and LEN, which are returned by PSSBRN, to have nonzero values for transformer branches. See Section 2.11 PSSBRN – Retrieve Branch Data for PSSBRN details.

Capability to define three-winding transformers was also added at PSS®E-27, but this will have no effect on existing programs that use USRCAS.

5.21.2 Prior to PSS®E-24

Load representation in PSS®E changed at PSS®E-24. There are no programming considerations other than those apparent from the changes described above. The following is a brief summary of those changes.

The PLOAD and QLOAD arrays were removed from the calling arguments for PSSBUS, the routine PSSCNV was completely removed and the routine PSSLOD was added. For older cases with converted loads, the CON array that was returned by PSSCNV is returned as the LOAD array from PSSLOD; the PLOAD and QLOAD arrays that were defined for PSSBUS and for PSSLOD are no longer defined for these routines. For older cases without converted loads, the values that were returned by PSSBUS in PLOAD(i) are now returned by PSSLOD as LOAD(1,i), the values that were returned by PSSBUS in QLOAD(i) are now returned by PSSLOD as LOAD(2,i), and the other values of LOAD are set to zero. LCONV is still returned by PSSMSC. Current cases will always return TRUE for LCONV.

5.21.3 Prior to PSS®E-20

Cases containing zone numbers of zero will have those values converted to 999.

5.21.4 Prior to PSS®E-18

PSS®E activity CASE will detect circuit ID's that contain an ampersand ("&") as their first character and request a different value. PSSBRN does not perform this check.

5.21.5 Prior to PSS®E-16

The Saved Case Data Extraction Routines cannot read PSS®E saved cases created by versions prior to PSS®E-16.

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