



Engineering Standard

SAES-A-202

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Saudi Aramco Engineering Drawings Preparation

Document Responsibility: Engineering Data & Drawing Systems Stds. Committee

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Summary of Change(s) (rev. 29 October 2019)

No.	Paragraph Number	Change Type (New, Modification,..)	Technical Change(s)
1	Appendix H	New	Added a new Appendix (H) to include the specifications for developing Building Information Modeling (BIM)
2	General	Modify	Comply with content confirmation requirements



1 Scope

This standard establishes a uniform means of Computer Aided Design & Drafting (CADD) standards used, in producing and modifying Saudi Aramco engineering drawings in electronic format.

2 Conflicts and Deviations

Any conflicts between this document and other applicable Mandatory Saudi Aramco Engineering Requirements (MSAERs) shall be addressed in writing to the EK&RD Coordinator.

Any deviation from the requirements herein shall follow internal company procedure SAEP-302, Waiver of a Mandatory Saudi Aramco Engineering Requirement.



3 References

Engineering Drawings shall be prepared and revised in accordance with all applicable Saudi Aramco standards, procedures and practices as well as those applicable international standards and practices approved by Saudi Aramco.

3.1 Saudi Aramco Documents

➤ Saudi Aramco Engineering Procedures

SAEP-148	<i>Mandatory Engineering Standards and Codes for Non-industrial, Public, and Government Facilities</i>
SAEP-301	<i>Instructions for Establishing and Maintaining Mandatory Saudi Aramco Engineering Requirements</i>
SAEP-302	<i>Waiver of a Mandatory Saudi Aramco Engineering Requirement</i>
SAEP-334	<i>Saudi Aramco Engineering Drawings</i>

➤ Saudi Aramco Engineering Standards

SAES-A-100	<i>Survey Coordinates, Datum, and Data Format</i>
SAES-A-503	<i>Energy Efficiency for Non-industrial Buildings- Except Low-rise Residential</i>
SAES-A-504	<i>Energy Efficiency for Low-rise Residential</i>
SAES-J-003	<i>Instrumentation and Control Buildings - Basic Design Criteria</i>
SAES-J-904	<i>FOUNDATION™ fieldbus (FF) Systems</i>

SAES-L-105	<i>Piping Material Specifications</i>
SAES-M-006	<i>Saudi Aramco General Purpose Fencing</i>
SAES-M-100	<i>Saudi Aramco Building Code</i>
SAES-P-104	<i>Wiring Methods and Materials</i>
SAES-P-107	<i>Overhead Distribution Systems</i>
SAES-P-116	<i>Switchgear and Control Equipment</i>
SAES-S-010	<i>Sanitary Sewers</i>
SAES-S-020	<i>Oily Water Drainage Systems</i>
SAES-S-030	<i>Storm Water Drainage Systems</i>
SAES-T-018	<i>Telecommunications -Symbols, Abbreviations, and Definitions</i>

➤ **Saudi Aramco Standard Drawings**

AA-036194, sheet 001	<i>Measurement Symbols</i>
AA-036196, sheet 001	<i>Final Control Element Symbols</i>
AB-036195, sheet 001	<i>Instrument Line Symbols</i>
AB-036204, sheet 001	<i>Letter Designation for Line Numbers</i>
AB-036227, sheet 001	<i>Standard Symbol for Piping Orthographic Drawings</i>
AB-036305, sheet 001	<i>Standard Equipment Symbols</i>
AB-036492, sheets 001-2	<i>Local Instrument Symbols for ILDs</i>
AB-036493, sheets 001-2	<i>ILDs, Panel Instrument Symbols</i>
AB-036766, sheets 001-3	<i>Standard Electrical Symbols - One Line Diagram</i>
AB-036766, sheet 004	<i>Standard Electrical Symbols – Plan Layout</i>
AC-036950, sheet 001	<i>Instrument Symbols</i>
AD-036491, sheet 001	<i>In-line Instrument Symbols for ILDs</i>
AD-036785, sheet 001	<i>Symbols Cathodic Protection</i>
AE-036193, sheet 001	<i>Instrument Device and Function Symbols</i>
AE-036411, sheet 001	<i>Drawing Indices</i>
AE-036411, sheet 002	<i>Mechanical Equipment Marking</i>
AE-036411, sheet 003	<i>Electrical Equipment Marking</i>
AE-036625, sheet 001	<i>Engineering Drawing Forms Layout</i>

➤ **Saudi Aramco General Instructions**

*GI-0710.002**Classification of Sensitive Documents***➤ Saudi Aramco Forms and Datasheets***SA-6078**Instrument Specification Sheet - Flow Instruments**SA-8009**Data Sheet - Fired Heater**SA-8020-419**Instrument Specification Sheet - Temperature Monitor***3.2 Auto-SACS**

3.2.1 Engineering Drawings must be prepared and revised using the latest approved version of Saudi Aramco Automated CADD Standard (Auto-SACS). Auto-SACS can be requested from EK&RD/Drawing Management Unit.

3.2.2 When certain standards are not available in Auto-SACS and/or contradicting to Saudi Aramco CADD Standards, prior approval must be obtained from the EK&RD/Drawing Management Unit Supervisor.

3.3 Industry Codes and Standards

American Institute of Architects

*AIA E202**Building Information Modeling Protocol*

International Organization for Standardization

*ISO 19650**Information Management Using Building***4 Terminology****4.1 Acronyms****BEP:** BIM Execution Plan**BIM:** Building Information Modeling**CADD:** Computer Aided Design and Drafting**CCS:** Cable and Conduit Schedule**CDE:** Common Data Environment**COBie:** Construction Operations Building Information Exchange**DCC:** Drawing Completion Certificate**DMU:** Drawing Management Unit**EK&RD:** Engineering Knowledge & Resources Division

EWO: Engineering Work Order

GIS: Geographic Information Systems

GSD: Geomatics Services Division

IIS: Instrument Installation Schedule

JO: Job Order

LOD: Level of Development

OEO: Operating Engineering Organization

MIDP: Master Information Delivery Plan

PIP: Project Implementation Plan

REO: Responsible Engineering Office

SDS: Smart Data Sheets



4.2 Definitions

3D Model: The spatial three dimensions containing graphical and non-graphical information about the model.

4D Simulation: A 3D representation geared with a fourth dimension being schedule or construction sequencing. The 4D simulation mimics the exact construction progress in 3D against the exact schedule items showing dependencies, predecessors, successor, and lead time.

5D Simulation: The fifth dimension is cost where all model elements and components generate cost figures at any given time in the project. Cost includes procurement, field engineering, and construction. The accuracy of cost matches the accuracy of the level of details (LOD).

Abbreviations and Letter Symbols: Shall be used where physical space prevents complete spellings as in title blocks and in small drawings. Abbreviations shall only be used when absolutely necessary and never be used when the meaning will not be clear. Saudi Aramco Standard Abbreviations and Letter Symbols must be used to maintain consistency within the Saudi Aramco documents. Abbreviations and Letter Symbols are listed in Saudi Aramco [eStandards](#) website under other documents. Other standard abbreviations commonly used in petroleum industry shall be used if an appropriate abbreviation is not found on the referred list.

As-built Drawing: An engineering drawing that has been revised to reflect actual field conditions after the completion of construction. Additions or changes to a drawing resulting from facility modification must also be verified as 'As-built'

and referenced to the Job Order (JO) in case of PMT, Engineering Work Order (EWO) in case of Design office and organization code in case of operation.



Auto-SACS: The automated tool that provides a unique method to apply Saudi Aramco CADD standards.

BIM Execution Plan: A document prepared by the CONTRACTOR at early stage of the project that outlines the overall framework along with implementation details of the scope implementation of the project. It is a living document continue to mature over the course of the projects deliverables and milestones. It usually collates/references a number of other documents including the Master Information Delivery Plan (MIDP) and the Project Implementation Plan (PIP).

Building Information Modeling (BIM): A digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle from earliest conception to demolition.

BIM Model: An object-oriented parametric 3D model representing physical, functional and other characteristics of the project (or its specific parts) in 3D as a complex of digital rich data elements.

CADD Drawings: Are engineering drawings generated electronically using software approved by Saudi Aramco as its standard medium for development and permanent retention as per the requirement of this standard and SAEP-334.

CDE (Common Data Environment): Software/hardware environment which enables the design data sharing. CDE is based on rules and procedures that facilitate management of BIM model creation and use, as well as collaboration between team members.

Construction Operations Building Information Exchange: Information exchange standard/protocol for BIM projects.

Collision Detection (Clash Detection): The process of identification, analysis and resolving design errors that emerge due to geometric intersections between model elements, violation of tolerances between model elements and/or overlap (spatial or chronometric) of resources in the construction schedule.

Data-Centric Systems: Are design systems used to develop Instrumentation, Electrical, Mechanical, Piping, or 3D drawings and engineering information in a database format. These formats will be used to generate 2D/3D drawings that are derived from these databases.

Demolition Drawing: Any existing drawing that shows the extent of the demolition work to be done. For details refer to SAEP-334 *Section 12*.

Drawing Completion Certificate: A document bearing the names and signatures of authorized persons accepting responsibility that the associated engineering drawings meet the applicable Saudi Aramco Engineering Standards and procedures. The DCC fulfills the approval/certification requirement in lieu of signing the title block of each drawing individually. Refer to SAEP-334 *Section 14*.

Drawing Number: An arrangement of eight alpha/numeric characters [prefix + size (separated by dash '-') + number] used to provide the unique identity for individual engineering drawings. Refer to [Section 6.4](#) of this standard.

Drawing Name: is file system name of the engineering drawing in a standard Saudi Aramco format. The name format is used when transferring drawings to or from EK&RD. Refer to [Section 5](#) of this standard for more details.

Engineering Knowledge & Resources Division: Of Engineering Services (ES) charged with the responsibility of analyzing and setting drawing related standards and procedures, ensuring the compliance of these standards, and having the custody and management of all Saudi Aramco Engineering and Vendor Drawings defined in, and governed by this standard and Saudi Aramco Engineering Procedure SAEP-334.

Emergency Drawing: An engineering drawing that has been designated by the Operating Engineering Organization (OEO) as being critical to the plant's operations during a disaster situation. These drawings are given top priority in every case.

Engineering Drawing: As used throughout in this standard, is a document produced on an approved Saudi Aramco engineering form, by Saudi Aramco (or for Saudi Aramco by approved sources) which bears a Saudi Aramco engineering drawing number and which was prepared for the purpose of identifying engineering related information to be used for the construction, operation, or maintenance of a Saudi Aramco plant and facility.

Engineering Forms: Are the approved forms used for the presentation of engineering information which bears an official Saudi Aramco form number followed by "ENG" abbreviation for Engineering and the latest date of form revision. Forms may vary in size depending upon the information being presented. The latest approved Engineering forms are available on the [eStandards](#) website.

Engineering Drawing File Types:

File Type	Status
Raster	No longer accepted
Hybrid	No longer accepted
PDF (Portable Document Format)	only accepted if generated from the data-centric

File Type	Status
	systems
Vector	acceptable
Spreadsheet	acceptable
Document	acceptable



iPlant: The sole corporate Saudi Aramco Engineering Drawing, Tags, and Data Management System that contains all approved and certified engineering data that are collected from the inception of the company. It is an automated system designed for administration and control of Saudi Aramco engineering drawings, tags, and data in a centralized library. It allows the users to query, view, print, retrieve, and submit engineering and vendor drawings in addition of allowing them to retrieve new engineering drawing numbers, tag numbers, create new sheet numbers, and to perform job tracking/creation functions. Refer to iPlant Users Guide for operational details.

Key Drawings: Are engineering drawings designated as essential for continued facility operation and maintenance. The Proponent Organization and Project Management jointly determine Key Drawing status. Refer to item [6.13](#) in this standard for list of key drawings.

Library Drawings: Are drawings of designs previously used or developed to be used as guidelines for new projects in Saudi Aramco facilities. Use of these drawings in future similar projects shall be considered. Library drawings provide “pre-designed” information that can be used on a repetitive basis. The utilization of Library Drawings can improve the use of stock material and eliminate the need for individual or unique designs. In addition, the use of Library Drawings provides savings by directly reducing drafting, design and engineering time in new projects. Library Drawings are archived on Plant M88 and governed by SAEP-334. They are available from the Saudi Aramco [eStandards](#) website.

LOD (Level of Development): The level of detail of a BIM element. LOD sets the minimum amount of geometric, spatial, quantitative, as well as any attribute information necessary for modeling at a particular stage of the object life cycle. The below LODs are standard definitions for Saudi Aramco projects:

- **LOD 100 (Conceptual Design):** The model is conceptual where elements have basic symbolic and geometric representations with approximate shape and orientation, but with no spatial and quantified accuracy.
- **LOD 200 (Preliminary Design Development):** Elements are graphically represented with a generic assembly where quantities, locations, and shapes are rough preliminary measures. The model may help in preliminary cost and scheduling estimates.

- **LOD 300 (Tender Design):** Elements have graphical representation where all objects are specified with accurate assembly. All quantities, size, shapes, locations, elevations, and orientation are actual representations. The model is at 10% accuracy in cost, scheduling, and construction.
- **LOD 400 (Construction):** Elements have the highest specified graphical representation with respect to assemblies, spatial locations, quantities, orientation of objects, and elevation details. The model is clash free with well maturity for cost, scheduling, fabrication, and installation at 5% accuracy.
- **LOD 500 (As-built):** The model reflects the verified As-built site conditions.

Responsible Engineering Office (REO): A Saudi Aramco “office” that has been entrusted with the production or revision of an Engineering Drawing. Non-Saudi Aramco firms or companies are not allowed to be the designated REO. Certain individuals within the REO shall be authorized to track issued existing Engineering Drawings and Facility Data.

Revision Status:

- a) **As-built:** refers to all contents of the drawing that have been certified as representing existing conditions based on site verification.
- b) **Developmental:** refers to a drawing in the process of being changed. While in a changing state the design agency may assign increment revisions at each review milestone.
- c) **Design Revision:** refers to a drawing revised to incorporate new proposed changes, but which has not been As-built.
- d) **Partial As-built:** refers to an existing drawing formerly certified as As-built but partially revised for new construction. The un-revised portions of the drawing continue to represent previous As-built condition.

Saudi Aramco: Shall mean Saudi Arabian Oil Company and its affiliated companies, including, but not limited to Aramco Overseas Company (AOC) and Aramco Services Company (ASC).

Standard Drawings: Are specially prepared engineering drawings that have been pre-approved by responsible Saudi Aramco organization for mandatory application in the design of Saudi Aramco facilities when the information they contain applies and is appropriate during design. The production of a Standard Drawing follows the normal production requirements presented in this Standard. Standard Drawings are archived in Plant 990 and governed by SAEP-334. They are available from the Saudi Aramco [eStandards](#) website.

Title Block: is the reserved portion of a drawing containing information about the drawing, project and plant. (See item 5 and [Appendix “A”](#) of this document).

Vendor drawing: Any document developed by a manufacturer that supports the technical requirements of material or equipment and received as part of a purchase order. The vendor drawings are also governed by SAEP-334 *Section 21*.

5 Drawing Name

Drawing Name must comply with the file naming convention. For example, files shall have a naming format for drawing BA-123456, sheet 001, revision 01 or 01A as follows:

5.1 Vector Drawings

Prefix + Number + Sheet + V + Revision

Example: B123456001V01 or B123456001V01A

5.2 Spreadsheet

Prefix + Number + Sheet + X + Revision

Example: B123456001X01 or B123456001X01A

5.3 Document

Prefix + Number + Sheet + W + Revision

Example: B123456001W01 or B123456001W01A

5.4 PDF (for Data-Centric Drawings only).

Prefix + Number + Sheet + P + Revision

Example: B123456001P01 or B123456001P01A

6 Title Block Information (Refer to [Appendix A](#))

6.1 Title Block Data Entry

Saudi Aramco drawing Title Block Automation (TBA) is a system designed to auto-generate the text box information within engineering drawing files.

The same information is also automatically written into the design file within an element that is normally hidden to the user. It can validate whether the Title Block information contained within each Design File contains errors, and report them when detected. The TBA includes three modules; Data Entry/Edit, Validation and Reporting. Refer to [Auto-SACS Read-me](#) file for details.

All date entries shall follow the format MM/DD/YYYY.

Uniqueness:

- 6.1.1 The drawing number uniquely identifies a drawing.
- 6.1.2 If a drawing is part of a set, the drawing number plus the sheet uniquely identify the sheet in a set of drawings.
- 6.1.3 If a drawing has been revised, the drawing number, plus the sheet, plus the specific revision uniquely identify the drawing.

6.2 Drawing Index

- 6.2.1 The Drawing Index is a single character in the range of A to Z (excluding I). For complete listing, refer to Standard Drawing AE-036411, sheet 001.
- 6.2.2 The Index is shown on Engineering Drawings in the title block. A maximum of two index letters are acceptable on a drawing, arranged by order of importance (not in alphabetic sequence) only the first index will be recorded in IPlant.
- 6.2.3 The Index implies, but does not determine, a group of associated types.

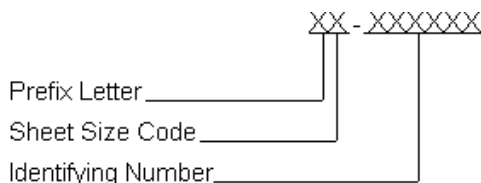
6.3 Drawing Type

- 6.3.1 Type is a three-character code.
- 6.3.2 Type implies, but does not determine, a group of closely related drawing titles. One of the associated titles may be used to develop the first line of the drawing title. For a complete listing of drawing types refer to [Appendix B](#).

6.4 Drawing Number

- 6.4.1 The Drawing Number provides one part of the “unique” identification code for each Engineering Drawing. It is comprised of a single alpha character Prefix Letter, a single alpha character Sheet Size Code, and six (6) alphanumeric characters identifying Number separated by a dash.
- 6.4.2 Typical Drawing Number that is entered in the engineering drawing. Refer to SAEP-334 for drawing number assignment.

Example: DB-765432



6.4.3 **Prefix Letter:** is a single character alpha code. The following Prefix Letters are currently used with new drawing numbers.

A	Standard Drawings only.
D	Library Drawings only.
B or T	Southern Area (Eastern Arabia).
H	Central Area (Eastern Arabia).
R or C	Northern Area (Eastern Arabia).
V or X	(Central and Western Arabia).

The following prefix letters appear on some of the existing Engineering Drawings but are no longer used on new drawing production. New sheets, however, can be added to the existing drawings using these prefixes.

A	Drawing numbers assigned by Aramco San Francisco or New York, AOC at Rome or London (except for Standard Drawing).
G	SOCAL
K	SCECO
L	Aramco Overseas Company, Beirut.
N	AOC, The Hague assigned drawing number.
X	ASC, Houston assigned drawing number.
D	Dhahran assigned drawing numbers (except for Library Drawings).

6.4.4 **Drawing Sizes:** is a single alpha character that defines the cut size of the drawing when printed or plotted. The following table shows the only acceptable sizes for Saudi Aramco Engineering Drawings.

SIZE CODE	OVERALL DIMENSIONS	
	mm	Inches
A	711 x 1016	28 x 40
B	508 x 711	20 x 28
C	356 x 508	14 x 20
D	279 x 432	11 x 17
E	216 x 279	8½ x 11

(Refer to Saudi Aramco [Auto-SACS](#))

6.5 Sheet Number

6.5.1 The Sheet Number is a three (3) digit numeric number ranging from 001 to 999 except for index/face sheets.

6.5.2 Values for Sheet Numbers are as follows:

Type of sheet	Lowest	Highest
Drawing sheet	001	999
Face/Index Sheet	FS1	FS9

6.5.3 Drawing Sets: When an Engineering Drawing has more than one sheet, it's called a set. Most Engineering Drawings of the same Drawing Type are grouped as Sets. Example: P&ID, ILD, and EIL, etc. Rules governing the use are as follows:

6.5.3.1 Sets must be made for a common engineering subject, the subject may be: Design, Process or Service within a specific engineering discipline. For Example:

DESIGN: such as Plot Plans, Structural Details, Equipment Layouts, Hazardous Area Classifications, etc.

PROCESS: such as Process Flow Diagrams, Piping and Instrument Diagrams, Instrument Loop Diagrams, etc.

SERVICE: such as Piping Isometrics of same product (e.g., Air, Steam, Fuel Gas, etc.) Electrical Drawings (e.g., One Line Diagram, Connection Diagram, Elementary Diagram., Electrical Layout, etc.), Instrument Points and Lines, etc.

6.5.3.2 For new construction, all sheets in a common set must be numbered sequentially without number gaps for 'Unused' sheets. If gaps are unavoidable, then an index sheet may be utilized to indicate "spare" in lieu of the unused sheet number.

6.5.3.3 A set of pre-numbered sheets (Engineering Forms) pertaining to one piece of equipment or instrument (e.g., Instrument Specification Sheets or Equipment Data Sheets, etc.), shall make up one drawing set. A drawing set shall not contain more than one equipment or instrument.

SA-6078 (set consists of one sheet)

SA-8009 (set consists of six sheets)

SA-8020-419 (set consists of two sheets)

6.5.3.4 Face/index Sheets may be provided for all size drawing sets having the same Drawing Numbers and more than ten sheets.

6.5.3.5 The first Face Sheet is numbered FS1. The subsequent Face sheets will be designated as FS2, FS3...FS9. When required to be revised, Face Sheets shall only have full numeric revision numbers (i.e., 01, 02, etc.).

6.5.3.6 Numbering sequences containing alpha characters are unacceptable.

Exceptions:

Face/Index sheet (FS1 to FS9).

Existing drawings bearing alpha/numeric sheet identification will be issued a new revision by the corporate drawing management system (iPlant).

6.5.3.7 Cover sheets or title sheets of a drawing or project shall not be assigned engineering drawing numbers.

6.5.3.8 As an example, a good practice for developing sets for Instrument Installation Schedules is by grouping them based on category of instruments like pressure, temperature, flow, level, relief valve, MOV/AOV/GOV/ZV, and miscellaneous by unit.

6.5.3.9 The second line title of individual sheets within a set may vary slightly, if so required for clarification and definition of location. However, plant number, unit, drawing index, and drawing type must be the same on all sheets.

6.5.3.10 Engineering forms except Scope of Work and List of Material must be a single file for each sheet. Data-Centric drawings like ISS, ILD, ECD, and ISD single file for multiple sheets.

6.6 Drawing Titles

The title is written on four (4) lines in the standard Title Block.

6.6.1 **Line 1, Content of the Drawing:** the general content of the drawing and the Drawing Type shall be entered on the first line. Use the appropriate approved descriptions as listed in Auto-SACS and shall not exceed 30 characters. The users may edit the first line based on the drawing contents as listed on TBA (Title Block Automation). However, this title shall match the drawing type. Loop number and line number shall be entered on first line for ILD and isometric piping details respectively. Similarly, equipment, instrument tag, or line number shall be mentioned on Safety Instruction Sheet (SIS), Data, or specification sheets for SMART DATA Sheets (SDS). TBA program matches this provision.

Type	First Line Title
ILD, ISO	ILD or ISO + the assigned loop or line number
SIS	SIS + the assigned line, equipment or instrument tag number

6.6.2 **Line 2, Subject or Service:** the main subject being covered by the drawing must be written here. This could be a process system, substation, service line, equipment number, building number, circuit or loop, etc. Use maximum of 35 characters as necessary to clearly explain the subject matter. Drawings concerning electrical substations shall have the substation number listed.

6.6.3 **Line 3, Plant Description:** the plant description of the plant corresponding with the plant number is written on this line. Use only the approved listing of plant descriptions. If two or more plants are covered, then only the description of the major plant covered by the drawing shall be on line 3. Other plants covered shall be specified as part of the note section.

Exception:

Offshore wellhead platforms where the platform name may be used.

6.6.4 **Line 4, Geographical Location:** The name of the Saudi Aramco geographic area where the facility is located. Geographic locations are shown in the plant list for each plant. The plant list is available in the title block data entry of Auto-SACS, IPlant and EK&RD web site. Any exception to this list must be approved by the Drawing Management Unit Supervisor. Abbreviations are not allowed on line 4.

6.7 Revision Number

6.7.1 Revision number is a two digit (in case of 100% field verified As-built) or three alpha-numeric characters (in case of design or partial As-built) number assigned per SAEP-334.

6.7.2 Full numeric revision numbers (i.e., 01, 02, 03, etc.) are assigned to 100% field verified As-built, cancelled drawings, face sheets and the drawings whose Plant number has been changed.

Commentary Note:

Not all full numeric revisions indicate As-built status. Revision 00 may enter the Engineering Drawing Library without being in the As-built state. Drawings whose Plant has changed or the drawings that are cancelled are promoted to the next full numeric revision, regardless of the As-built status of the original drawing. The drawing user must evaluate the drawing and its revision history to determine As-built status.

- 6.7.3 Design and partial As-built revisions are indicated by two numbers followed by an alpha character (A-Z, excluding I and O).
- 6.7.4 Each revised drawing must include information such as date, description, associated job number, and revision number in the drawing revision block.
- 6.7.5 Revisions to non-certified drawings are considered developmental. Alpha characters for new drawings, i.e., A, B, C, D, etc., and alpha/numeric for existing drawings, i.e., 1A1, 1A2, 1A3, etc., may be used as developmental revisions. Once it is determined that the drawing will be issued for construction, REO must assure that developmental revisions are removed and that the issued revision is reflected prior to certification and submittal to EK&RD.
- 6.7.6 This table provides sample revision numbers, with descriptions and indicates if the revision is allowed to exist in IPlant.

Revision	iPlant	Meaning
00	YES	Drawings entering the iPlant as new drawings (Issued For Construction) are all revision 00.
03	YES	As-built for existing drawing (see notes in 6.7.2)
A, B,C,	NO	Development Revision for new drawing
0A1, 0A2	NO	Developmental revision for existing drawing
03C	YES	Design or partial As-built revision to revision 03.

6.8 Plant Numbers

A three character code that indicating a facility, process or system. Plant codes are issued and controlled by EK&RD.

- 6.8.1 Plant numbers are three alpha/numeric characters in length.
- 6.8.2 Only one active Plant Number shall be assigned to an Engineering Drawing.

Exception:

More than one plant number may be allowed under certain circumstances (Only the primary plant number will be recorded in corporate system). Approval must be obtained from Standard and Compliance Group Leader if multiple plants are required.

Example:

When the drawing contains interrelated information for more than one plant: continuation of lines, interface points, jumpers, tie-in points, etc., and all such plants fall under the responsibility of the same operating organization.

- 6.8.3 When an Engineering Drawing is ‘typical’ for more than one plant, then a separate drawing must be produced for each plant.
- 6.8.4 While changing the plant number of an existing drawing, revise the drawings that involve changing the plant number and plant description in the title block and state in the revision description “CHANGED PLANT NO. FROM XXX to YYY” along with As-built revision, if any.
- 6.9 **Job Order/EWO Numbers:** The Job Order (JO) Number assigned from the ERP System or the Engineering Work Order (EWO) Number shall be shown on Engineering Drawings in the title block. Below are samples of JO numbers:
- OEO JO number = 765200 (Department ORG Code)
- IDO JO number = 04C123 (EWO number)
- PMT JO number = 10-12345-1234 (BI number + 4 digits)
- 6.10 **Drawing File Type:** The rectangular box provided at the bottom right corner of the border must indicate file type.
- 6.11 **Emergency Drawings:** See item 2 for definition. Ensure that all drawings are properly stamped for quick identification.
- 6.12 **Information Sensitivity:** All Saudi Aramco engineering drawings are classified as per GI-0710.002.
- 6.13 **Key Drawings:** The following drawing types are required but not limited to be designated as Key Drawings:

DWG TYPE	DESCRIPTION	DWG Index
PID	Piping and Instrument Diagrams	A
PFD	Process Flow Diagram	A
VOD	Valve Operating Diagram	A
EQA	Equipment Arrangement / Layout / Location / Legend / Marine Equipment	A/C/R/T/V
FPP	Facility Plot Plan	A
PPL	Underground / above ground Piping Installation Plans	L
PPL	Piping Plan / Layout / Arrangement	L
E1L	Electrical One / Three Line Diagrams	P
LOG	ESD Logic Diagrams	J
ILD	Instrument Loop Diagrams	J
HAZ	Area Classification Plans	B
ARC	Building Floor Plans and Elevations	R
DAT	Equipment Data Sheets	C/D/E/F/G/K/L/M

DWG TYPE	DESCRIPTION	DWG Index
SIS	Safety Instruction Sheets	A
IIS	Instrument Installation Schedules	J
ISS	Instrument Specification Sheets	J
CBL	Cable Schematics	T/P*
LDT	Line Designation Table	A

Other engineering drawings may be designated as Key drawings by the Proponent Organizations or the Project Management Team jointly with the Proponent Organization as appropriate for their specific projects prior to the start of project detail design.

P index for Offshore Projects*

- 6.14 **Review for Key Drawing:** Review required box in the title block shall be marked to indicate the requirement for review of key drawings by Saudi Aramco PMT and Operations.
- 6.15 Design Certification, Review for Key Drawing, and Revision Validation: shall be completed as required by filling in the designated box in the drawing title block as per SAEP-334 *Section 14*.
- 6.16 **Drawing Scales**
- 6.16.1 Graphic Scale, a line scale reference shall be included on both new and existing drawing just over the title block on scale drawings. The line scale shall be divided into units of length as determined by the scale of the drawing. Refer to Auto-SACS for a list of graphic scales symbols.
- 6.16.2 The seed files and attached borders are created at 1:1 scale. To create a new drawing to any desired scale, the seed file and attached border must be enlarged to that specified scale. In the title block program menu, the correct scale must be placed in the field "SCALE" for the correct placement of title block attributes.
- 6.16.3 Scale symbols MUST match the border scale.
- 6.16.4 PID, EIL, VOD, ILD, and PFD products do not support scale drawings.
- 6.16.5 For scaled drawings, use the auto-dimensioning command where applicable and don't drop it.
- 6.16.6 Do not scale down drawings, instead, rearrange the drawing or split the drawing into two drawings.
- 6.16.7 The setting of all Saudi Aramco border files are set at (Global Origin) GO=0, 0. This 'GO' is defined at the left bottom corner of the border. No changes are allowed in the GO setting for all drawing types including scaled drawings.

- 6.17 Reference drawings and notes shall be placed in the area provided above the title block. Reference drawings listed shall be the necessary minimum engineering drawings only. Do not include Standard Drawings and do not include Plant, Index nor Revision Number reference of the referenced drawings.

6.18 Unit Number

- 6.18.1 Unit number is a 2 to 4 alphanumeric code that indicates a process or system. All unit codes shall be requested from iPlant. For small plants, which are not required to be segregated into multiple units, the plant shall have at least one unit number which preferably be the same as the plant number.

- 6.18.2 Unit number is 2 to 4 alphanumeric in length.

Exception:

For offshore and onshore wellhead platforms, wellheads, trains, units, etc., where units are not uniquely defined each platform shall be prefixed by the abbreviation of location to make each unit unique. Location abbreviation shall be of 4 alpha characters and sequence numbers shall be of 4 numeric digits.

7 Drawing Cancellation

Engineering Drawings must be cancelled under the circumstances identified below; as per SAEP-334.

- 7.1 A facility, plant, installation, or a piece of equipment has been abandoned, removed, dismantled, or transferred.
- 7.2 The drawing has been superseded by another drawing.

8 Demolition Drawing

- 8.1 Cloud and crosshatch the areas to be demolished without obscuring the information in the area being crosshatched.
- 8.2 Describe in the revision block against the demolition revision.
- 8.3 For further design, obtain a new revision number per SAEP-334.

9 As-built Drawing

All key and emergency drawing must be updated to AS-BUILT condition. Non-key drawings shall be brought to AS-BUILT condition whenever change happened in the field. Revision description shall be described in the revision block for the As-built condition as follows:

- 9.1 As-built; when a drawing is certified as field verified with no changes.
- 9.2 Revised As-built; when a drawing is certified as field verified with changes. Description shall be clearly identified. Refer to item 3.8 for more details.

10 Tag Number

Tag numbers are assigned and managed through iPlant by order of numerical sequence within each category or type within the designated plant. All tag numbers, except piping, shall be prefixed by Plant Number separated by a single dash. All Instruments tags shall be prefixed by both Plant Number and Unit Number separated by a single dash.

Exception:

For offshore and onshore wellhead platforms, wellheads, trains, units, etc., where tags are not uniquely defined, the tag shall be prefixed by a unit number to make each tag unique.

- 10.1 Cable and Conduit Tag Numbers:** The tag number shall be unique for each plant. Each cable and conduit tag shall consist of 4 parts separated by single dashes:

1. Plant Number
2. Unit Number
3. Cable/Conduit Marking
4. Sequence Number (5 numeric digits)

Example #1: K85-001-C-00036

Example #2: K85-100-PC-01281

Cable/Conduit Markings	
C	Conduit
CC	Electrical Control Cable
PC	Power Cable
IC	Instrument Cable

- 10.1.1 The cable/conduit marking letter designations are 1 to 2 alpha characters signifying the type of service.
- 10.1.2 Cable and Conduit Numbers shall be assigned in strict numerical sequence starting from 00001, for each particular plant regardless of the size, type or service. Alpha suffix is not allowed.
- 10.1.3 Information related to each Cable and Conduit shall be entered in the Cable and Conduit Schedule (CCS).

10.2 Mechanical Equipment Tag Numbers: Each mechanical equipment tag number is unique for a specific piece of equipment or an associated item within each plant. Each mechanical tag shall consist of 3 parts separated by single dashes:

1. Plant Number
2. Mechanical Equipment Marking
3. Sequence Number (4 numeric digits) + Suffix (1 letter – when applicable):

Example #1: D31-G-0012

Example #2: D31-GM-0012A

9.2.1 The mechanical equipment marking letter designations are 1 to 2 alpha characters as per Standard Drawing AE-036411 Sheet 002.

9.2.2 Data sheets and Safety Instruction Sheets (if applicable) must be developed for each piece of mechanical equipment per SAEP-334.

10.3 Electrical Equipment Tag Number: Each electrical equipment tag number is unique for a specific piece of equipment within each plant. Each electrical tag shall consist of 4 parts separated by single dashes:

1. Plant Number
2. Power Source
3. Electrical Equipment Marking + (POD Code)

Commentary Note:

PDD code when Applicable, enclosed within parenthesis.

4. Voltage Code + Sequence Number (3 numeric digits)

Example #1: D31-012-GSW(K)-5002

Grounding Switch # 002 has 69 kV voltage from substation #12 and PDD code K in plant number D31.

Example #2: D31-012-BC-3001

Battery Charger # 001 has 13.8 kV voltage from substation #12. No POD code in plant number D31.

10.3.1 POD codes are required only with the below Electrical Equipment Markings.

Description	Standard Marking	POD
Circuit Switcher	CSW	S
Circuit Breaker (Power)	CB	A
Circuit Breaker (Switchgear)	CB	B

Description	Standard Marking	POD
Disconnecting Switch	DSW	D
Fuse	FS	F
Fuse Disconnect	FSD	J
Grounding Switch	GSW	K
Grounding Resistor	GR	Y
Grounding Transformer	GT	X
Relay	RY	P
Switch	SW	E
Transformer	XFR	T

10.3.2 The following are the approved voltage codes:

Voltage Codes	Voltage Description
0	600 V and below AC or DC
1	2.4 kV
2	4.16 kV
3	13.8 kV
4	34.5 kV
5	69 kV
6	115 kV
7	230 kV
8	380 kV

10.3.3 The electrical equipment marking letter designations are 1 to 3 alpha characters as per Standard Drawing AE-036411 Sheet 003.

10.4 Instrument Tag Number: Each instrument tag is unique within a plant. Each instrument tag shall consist of 4 parts separated by single dashes.

1. Plant Number
2. Unit Number
3. Instrument marking (2 to 5 letters)
4. Sequence Number (5 numeric digits) + Suffix (1 letter – when applicable)

Example #1: K85-100-PCV-00159

Example #2: B22-001-LT-00054

Example #3: H46-020-MOV-10010A

10.4.1 Information related to each instrument shall be entered in the Instrument Installation Schedule (IIS).

10.4.2 The instrument marking letter designations are 2 to 5 alpha characters as per SAES-J-003.

10.5 Loop Tag Number: Each loop tag is unique within a plant. Each loop tag shall consist of 4 parts separated by single dashes.

1. Plant Number
2. Unit Number
3. Loop Marking (1 letter)
4. Sequence Number (5 numeric digits)

Example #1: K85-100-P-00005

Example #2: B22-001-L-00002

Example #3: H46-020-T-10001

10.5.1 The instrument marking letter designations are 2 to 5 alpha characters as per SAES-J-003.

10.5.2 Instrument Loop Diagram shall be prepared as per SAES-J-003.

10.6 Line Tag Number: Each line tag is unique within a plant.

Each line tag shall consist of 4 parts separated by single dashes.

1. Nominal Diameter
2. Fluid Codes
3. Sequence Number (5 numeric digits)
4. Piping Material Class

Example: 2-1/2"-CWS-12345-1CS1P1

10.6.1 The nominal diameter consists of up to five characters followed by the inch symbol. All nominal line sizes are expressed in inches even on metric drawings.

10.6.2 The fluid codes are as per Standard Drawing AB-036204.

10.6.3 Piping material class codes are as per SAES-L-105.

10.6.4 Information related to each pipeline shall be entered in the Line Designation Table (LDT).

10.7 Tag To Drawing Association

A spreadsheet file shall be delivered with a list of all used tags associated with their respective drawings. The list shall include all engineering tags and all types of submitted drawings. Each row shall represent one tag to its drawing

association. The list shall be submitted under the following standard headings: Plant, Unit, Drawing, Tag as shown in the below example.

PLANT	UNIT	Drawing	TAG
B22	001	BA-123456001	B22-G-1005A
B22	001	BE-323432001	B22-G-1005A
B22	002	BA-654321001	4"-P-04362-1CS1P
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11 Drafting Requirements

- 11.1 Existing drawings must be utilized for any modification of a facility. Creation of new drawings to indicate a change in an existing facility will not be accepted. If, however, this is unavoidable for some reason such as being too crowded or major revision changes, then a new sheet shall be added to the existing drawing.
- 11.2 New drawings that are created as a continuation of an existing design are considered as continuation drawings of that design bearing the next sequential (numeric) sheet number of that drawing set.
- 11.3 When revising an existing drawing, the incorrect and unreadable information on the title block including plant description and drawing type shall be corrected or completed.
- 11.4 Revision diamonds shall be placed in the drawing area in such a way as to make it possible to locate revisions quickly.
- 11.5 Old revision diamonds, clouds and related notes must be removed from the drawing.
- 11.6 If a drawing is completely redrawn, the words “Completely redrawn and incorporated revisions (indicate the revision number incorporated)” are put in the revision block.
- 11.7 When revising some pages of bulk drawings that have a single electronic file of the complete set such as list of material, the revision block of only first sheet shall indicate the changes and revision number change. Complete set shall be submitted.
- 11.8 The standard north arrow symbol shall be drawn in a prominent place for all plan view drawings preferably in the upper left region of the drawing. It must be drawn pointing upward, or if unavoidable, pointing left or right, but shall never point down.

Exception:

For new generated drawing that has continuation link to the existing drawings that have north arrow symbol pointing down and Plan & Profile (PRF) of pipelines will remain the same.

- 11.9 Information covered by Standard Drawings, elaborated details, unnecessary views, and repetitions, which add no value to the drawings, shall be omitted.
- 11.10 All non-essential items (such as Logo's) from design which add nothing to the accuracy, completeness, and clarity of the drawing shall be eliminated.
- 11.11 Drawing shading is not allowed on drawings. Hatching may be used as an alternative to shading. Auto-SACS cells are an exception.
- 11.12 Revisions on drawings may be encircled or clouded on the prescribed layer for easy identification of the revised portion during certification and review cycle. However, for 100% As-built drawings, all revision encirclement or clouding must be either removed or the level turned off prior to submitting the drawings to EK&RD.
- 11.13 The letters "O" and "I" shall not be used for identification symbols on the drawings, as they are often confused with Zero and One.

Exception:

Exceptions are instrument symbols as shown in SAES-J-003.
- 11.14 Text on drawings shall always be uppercase.
- 11.15 Engineering drawings shall not be developed for any purpose in lieu of Standard Drawings and neither shall they be copied from Standard Drawings under any circumstances without the written permission by the committee chairman of that Standard Drawing.
- 11.16 Drawings that are not generated from the Data-Centric Systems must be 100% vector.
- 11.17 Existing Raster/ Hybrid drawings issued by the COMPANY for revision purposes shall be upgraded to vector.
- 11.18 Existing data sheets that are in Raster (scanned) format MUST be converted to Saudi Aramco approved spreadsheet forms or PDF files in case of Data-Centric. Refer to SAEP-334 Section 15.2 for Data-Centric drawings.

12 CADD Standards

12.1 General

Saudi Aramco CADD standards and Auto-SACS were developed to maintain the consistency of drawings. Auto-SACS contains collections of seed files, cell libraries, border files, levels, line weights, font, line codes and Title Block Automation (TBA).

12.1.1 Version

Contractor shall submit the drawings in the latest software version approved by Saudi Aramco at the time of submittal.

12.1.2 Seed and Border Files

The Saudi Aramco seed and border files are available in the latest version of [Auto-SACS](#). Refer to [Appendix C](#) of this standard for more details.

12.1.3 Data-Centric Templates

12.1.3.1 All drawings created using the Data-Centric systems shall be created using the latest approved Saudi Aramco Data-Centric templates.

12.1.3.2 The final submittal of the data-centric databases shall be upgraded by Contractor to the latest approved software version by EK&RD at the time of submittal.

12.2 Requirements

To ensure maximum productivity from Saudi Aramco CADD systems, the CADD standards parameters must be followed.

12.2.1 All design files must be created from the applicable Saudi Aramco seed file.

12.2.2 Do not override or change the seed file setups and working units.

12.2.3 Saudi Aramco forms (borders) must be referenced only. Do not include forms as part of the design file. A border must be attached with the CADD drawing.

12.2.4 The drawings submitted to iPlant shall have no reference files attached, except for the Saudi Aramco border files which must be attached in accordance to this Standard and Saudi Aramco Engineering Procedure SAEP-334. The DESIGN CONTRACTOR shall ensure that all reference drawings are merged with the submitted drawing.

12.2.5 Do not drop or change Standard Cells. In case it is necessary to add or modify cells, a prior approval is required from EK&RD.

- 12.2.6 All elements in schematic type drawings (non-scale) must be placed with grid/unit lock set to ON position.
- 12.2.7 File design to display the drawing such as that view 1 (maximized) showing the title block with data fields turned on position. View 5 (maximized) showing the entire drawing with data fields turned off position.
- 12.2.8 Remove all contents outside drawing border.

Appendix A – Saudi Aramco Engineering Drawing Title Block

Refer to the latest version of **INDEX.CFG** file in Auto-SACS

The diagram illustrates the layout of the Saudi Aramco Engineering Drawing Title Block, with various sections labeled for reference:

- section 6.16**: SCALE: _____
- section 6.15**: REVISION VALIDATION
- section 6.14**: THIS REVISION NO. _____ IS COVERED, FOR ALL APPROVAL AND CERTIFICATION REQUIREMENTS, PER SAEP-334, UNDER DRAWING COMPLETION CERTIFICATE NO: XX-XXXX-XXXX-XXX
- section 6.13**: DESIGN CERTIFICATION (DESIGN AGENCY) REVIEW FOR KEY DRAWINGS (SAUDI ARAMCO) OTHER
- section 6.12**: ENGG./DATE CERTIFIED BY/DATE CONST. AGENCY/DATE OPERATIONS/DATE BY/DATE
- section 6.11**: REV.NO. DATE REVISION DESCRIPTION
- section 6.10**: JOB ORDER/EWO NO. THIS REVISION IS NOT TO BE USED FOR CONSTRUCTION UNTIL CERTIFIED AND DATED
- section 6.9**: SAUDI ARABIAN OIL COMPANY
- section 6.8**: DRAWING TYPE
- section 6.7**: SAUDI ARABIA
- section 6.6**: UNIT NO. PLANT NO. INDEX DRAWING NUMBER SHT. NO. REV. NO.
- section 6.5**: EMERGENCY DRAWING
- section 6.4**: RESTRICTED
- section 6.3**: VECTOR CADD-02
- section 6.2**: Saudi Aramco 2615-1 ENG. (09/03)
- section 6.1**: section 6.18

Appendix B – Saudi Aramco Drawing Types

Refer to the latest version of **INDEX.CFG** file in Auto-SACS

DRAWING TYPE	DESCRIPTION	DRAWING SIZE	COMMENTS
INDEX 'A'			
ABB	MARKERS & SIGNAGE	A-B-C-D	ROAD SIGNS, PIPELINE MARKER, etc.
DOC	SCOPE OF WORK	E	
DSC	DRAWING CONTROL SHEET	D	
EQA	EQUIPMENT ARRANGEMENT/LAYOUT/ LOCATION/LEGEND	A-B-C	
FPP	AREA MAPS	A-B-C	
FPP	FACILITY INDEX MAP	A-B-C	
FPP	FACILITY PLOT PLAN	A-B-C	
FPP	GENERAL LAYOUT PLAN	A-B-C	
FPP	GRID MAP	A-B-C	
FPP	MASTER PLOT PLAN	A-B	
FPP	OVERALL PLAN	A-B	
FPP	SITE PLAN/LOCATION PLAN	A-B	
FPP	TOPOGRAPHIC & CONTOUR MAP	A=B	
FPP	VICINITY MAP	A-B	
HGR	HYDROGRAPHIC MAP	A-B	
HYD	HYDROSTATIC TEST DIAGRAM	A-B-C-D	
HYD	SYSTEM LEAK TEST	A-B	GAS
LDT	LINE DESIGNATION TABLE	D	
MSD	MATERIAL SELECTION DIAGRAM	A	
PFD	PROCESS FLOW DIAGRAM	A-B-C-D	
PFD	UTILITY FLOW DIAGRAM	A-B-C-D	
PID	PIPING & INSTRUMENT DIAGRAM	A-B	
PRF	PLAN & PROFILE/PIPELINE ALIGNMENT	A-B-C	
SIS	SAFETY INSTRUCTION SHEETS (EQUIPMENTS/CRITICAL PIPING)	E	Line #1 shall also include Equip Tag or Line No.
VOD	VALVE OPERATING DIAGRAM	A-B-C-D	
INDEX 'B'			
FPS	AUTOMATIC SPRINKLER LAYOUT/DETAIL	A-B-C	FIRE PROTECTION SYSTEM
FPS	BLOCK DIAGRAM FIRE ALARM SYSTEM	A-B-C	
FPS	FIRE PROOFING/FIRE BREAKS & FIRE WALLS	A-B-C	
FPS	INSTALLATION DETAIL	A-B-C	FIRE FIGHTING SYSTEM
FPS	LAYOUT/PLAN/SECTION/DETAIL	A-B-C	PORTABLE SAFETY EQUIPMENT
FPS	PLAN/LAYOUT/DETAIL	A-B-C	FIRE PROTECTION SYSTEM
FPS	PLAN/LAYOUT/DETAIL	A-B-C	HALON FIRE PROTECTION SYSTEM
FPS	PLAN/LAYOUT/RISER DIAGRAM	A-B-C	FIRE ALARM SYSTEM
HAZ	AREA CLASSIFICATION	A-B-C-D	

DRAWING TYPE	DESCRIPTION	DRAWING SIZE	COMMENTS
HAZ	ELECTRICAL AREA CLASSIFICATION	A-B-C-D	
HAZ	FIRE HAZARDOUS AREA	A-B-C-D	
HAZ	HAZARD IDENTIFICATION CHECK LIST	E	
HAZ	HAZARDOUS AREA CLASSIFICATION	AB-C-D	
HAZ	LIGHTNING PROTECTION LAYOUT / DETAILS	A-B-C-D	
INDEX 'C'			
DAT	DATA SHEET	D-E	
SDS	SMART DATA SHEET	D-E	
EQD	PLAN & DETAILS	A-B-C	
MDT	SCRUBBER ASSEMBLY DETAILS	A-B-C-D	
MDT	STRIPPER ASSEMBLY DETAILS	A-B-C-D	
INDEX 'D'			
APP	LAYOUT OF APPURTENANCES	B-C-D	
DAT	PRESSURE VESSEL DATA SHEET	D	
SDS	SMART DATA SHEET	D	
EQD	ASSEMBLY/DETAILS (VESSELS, TANKS COLUMNS, SPHEROIDS)	A-B-C-D	
EQD	ASSEMBLY/DETAILS EQUIPMENT NO.	D	Add equipment number in Line #1.
EQD	FABRICATION DETAILS	A-B-C	
INDEX 'E'			
DAT	DATA SHEET - SHELL & TUBE HEAT EXCHANGER	D	
SDS	SMART DATA SHEET	D	
EQD	DETAILS	A-B-C-D	EQUIPMENTS
INDEX 'F'			
APP	LAYOUT OF APPURTENANCES & ASSOCIATED STACKS	A-B-C	
DAT	DATA/SPECIFICATION SHEET - (FLARES/EQUIPMENTS)	D-E	
SDS	SMART DATA SHEET	D-E	
EQD	DETAILS	A-B-C-D	
MDT	BURNER PIT PLAN/DETAIL	A-B-C-D	
INDEX 'G'			
DAT	DATA SHEET – PUMP	D-E	
EQD	ASSEMBLY DETAIL	D-E	
SDS	SMART DATA SHEET	D-E	
INDEX 'H'			
SCH	PAINTING/COATING SCHEDULE	B-C-D	
INDEX 'J'			
ECD	INSTRUMENT CONNECTION/ INTERCONNECTION DIAGRAM	A-B-C-D	
EWD	INSTRUMENT WIRING DIAGRAM	A-B-C-D	
IDT	INSTRUMENT LAYOUT/PLAN/SECTION/ DETAIL/ASSEMBLY/INSTALLATION OR MOUNTING DETAILS	A-B-C-D-E	
IIS	INSTRUMENT INSTALLATION SCHEDULE	D	
ILD	INDEX SHEET (INSTRUMENT LOOP DIAGRAM)	B-C-D	

DRAWING TYPE	DESCRIPTION	DRAWING SIZE	COMMENTS
ILD	INSTRUMENT LOOP DIAGRAM	B-C-D	Loop Number shall also be entered in Line #1.
IPD	INSTRUMENT PIPING/INSTALLATION DETAIL	A-B-C-D	
IPL	INSTRUMENT CABLE/CONDUIT PLAN	A-B-C	
IPL	INSTRUMENT LOCATION PLAN	A-B-C	
IPL	INSTRUMENT POINTS & LINES	A-B-C	
ISD	INSTRUMENT SEGMENT DIAGRAM	B-C-D	
ISS	INSTRUMENT SPECIFICATION SHEET	E	Line #1 shall also include Instrument Tag Number.
ISS	ORIFICE PLATE DETAIL	E	
LOG	CAUSE & EFFECT DIAGRAM	A-B-C-D	
LOG	ESD/PLC LOGIC DIAGRAM	A-B-C	
LOG	FUNCTIONAL DIAGRAM	A-B-C	
LOG	LOGIC DIAGRAM	A-B-C	
MTL	INSTRUMENT MATERIAL SUMMARY SHEET	E	
PNL	INSTRUMENT PANEL LAYOUT/SECTION ARRANGEMENT/DETAIL	A-B-C-D	INSTRUMENT PANEL/ LOCAL CONTROL PANEL/ ANNUNCIATOR BOARD/GRAPHIC PANEL
PNL	LAYOUT/DETAIL/ARRANGEMENT/SECTION	A-B-C-D	INSTRUMENT PANEL/ LOCAL CONTROL PANEL/ ANNUNCIATOR BOARD/GRAPHIC PANEL
RAK	INSTRUMENT RACK LAYOUT/DETAIL	A-B-C	
RAK	RACK LAYOUT	A-B-C	
SCH	INSTRUMENT CONNECTION/WIRING SCHEDULE	A-B-C-D	
SCH	LIST OF NAMEPLATES FOR INSTRUMENTS	D	
SCH	PANEL SCHEDULE/PANEL INTERCONNECTION SCHEDULE	A-B-C-D	
SCH	INPUT/OUTPUT DISTRIBUTED CONTROL SYSTEM (DCS)	D-E	
SCM	INSTRUMENT BLOCK DIAGRAM	A-B-C-D	
INDEX 'K'			
DAT	DATA SHEET - (EQUIPMENTS)	E	
SDS	SMART DATA SHEET	E	
HVA	AC DUCT FABRICATION LAYOUT/DETAIL	A-B-C	
HVA	COMPRESSOR LAYOUT/PLAN/ ASSEMBLY/DETAIL	A-B-C	
HVA	HVAC CHILLED WATER PIPING	A-B-C	
HVA	HVAC CONTROL DIAGRAM	A-B-C	
HVA	HVAC EQUIPMENT ASSEMBLY/LAYOUT/DETAIL	A-B-C	
HVA	HVAC LAYOUT/PLAN/DETAIL/DIAGRAM	A-B-C	
HVA	HVAC SYMBOLS/LEGEND	A-B-C	
HVA	VENTILATION SYSTEM	A-B-C	
SCH	EQUIPMENT SCHEDULE	A-B-C-D	
INDEX 'L' Process Piping			
DAT	VALVE DATA SHEET	E	
ISO	ISOMETRIC PIPING DETAIL	B-C-D	Line # 1 shall include the Line Number.
OSI	ON-STREAM INSPECTION	B	
PDT	PIPING DETAIL - PROPORTIONING PUMP	D	
PDT	PIPING DETAIL SHEET	D-E	
PDT	PIPING SECTION/DETAIL/ELEVATION	A-B-C	

DRAWING TYPE	DESCRIPTION	DRAWING SIZE	COMMENTS
PPL	PIPELINE ROUTING (ABOVE/UNDER GROUND/SUB MARINE)	A-B-C	RACEWAY/CORRIDOR
PPL	PIPING DRAWING INDEX	A-B-C-D	
PPL	PIPING PLAN/LAYOUT/ARRANGEMENT	A-B-C-D	
SCH	TIE-IN SCHEDULE	B-C-D	
SCM	PIPING SCHEMATIC DIAGRAM	A-B-C-D	
INDEX 'M'			
DAT	DATA SHEET FOR OFFSHORE PLATFORM	D	
SDS	SMART DATA SHEET	D	
SCH	ANCHOR BOLT SCHEDULE	B-C-D	
SDT	FENCE PLAN/DETAIL/LAYOUT	A-B-C	
SDT	LADDER/HANDRAIL DETAILS, ASSEMBLY	A-B-C	
SDT	OFFSHORE PLATFORM PLAN/SECTION/ ELEVATION/DETAIL	A-B-C	
SDT	PIPE RACK DETAIL	A-B-C	
SDT	PIPE SUPPORT DETAIL/SCHEDULE/ ELEVATION	A-B-C-D	
SDT	PIPEWAY SLEEPER PLAN/SECTION/ ELEVATION/DETAIL	A-B-C-D	
SDT	ROOF FRAMING PLAN/SECTION/DETAIL/ELEVATION	A-B-C-D	
SDT	STRUCTURAL DETAILS/ELEVATION/LAYOUT/PLAN	A-B-C	INCLUDES STEEL PILES/STEEL STAIRS
SDT	STRUCTURAL PLATFORMS	A-B-C	
SDT	TRUSS DETAIL/SECTION/ELEVATION	A-B-C	
SDT	WALKWAY PLAN/SECTION/ ELEVATION/DETAIL	A-B-C	
INDEX 'N'			
INS	INSULATION DETAIL	A-B-C-D	
INDEX 'O' Security Drawings			
SPP	AREA MAP	A-B	
SPP	OVERALL PLAN	A-B	
SPP	FACILITY LAYOUT	A-B	
SPP	TOPOGRAPHIC & CONTOUR MAP	A-B	
SPP	VICINITY MAP	A-B	
PER	SECURITY FENCE PLAN/LAYOUT/DETAIL	A-B-C	
PER	SECURITY PATROL ROAD PLAN/LAYOUT/DETAIL	A-B-C	
PER	SECURITY FENCE LIGHTING PLAN/LAYOUT/DETAIL	A-B-C	
PER	SECURITY LIGHTING COVERAGE/LIGHT INTENSITY/DISTRIBUTION	A-B-C	
PER	SECURITY FENCE ELECTRICAL PLAN/LAYOUT/DETAIL	A-B-C	
GAT	GATE PLAN/LAYOUT/DETAIL	A-B-C	
GAT	GATEHOUSE PLAN/LAYOUT/DETAIL	A-B-C	
GAT	GATEHOUSE LIGHTING PLAN/LAYOUT/DETAIL	A-B-C	
GAT	GATEHOUSE ELECTRICAL PLAN/LAYOUT/DETAIL	A-B-C	
GAT	GATEHOUSE NETWORK PLAN/LAYOUT/DETAIL	A-B-C	
GAT	GATEHOUSE BALLISTIC PROTECTION PLAN/LAYOUT/DETAIL	A-B-C	
SCE	IDAS NETWORK PLAN/LAYOUT/DETAIL	A-B-C	
SCE	IDAS CAMERA FIELD OF VIEW/LAYOUT/DETAIL	A-B-C	
SCE	IDAS SENSORS PLAN/LAYOUT/DETAIL	A-B-C	

DRAWING TYPE	DESCRIPTION	DRAWING SIZE	COMMENTS
SCE	RADAR COVERAGE PLOT ON TOPOGRAPHIC/CONTOUR MAP	A-B-C	
SCE	ACCESS/ALARM ENTRY CONTROL SYSTEM PLAN/LAYOUT/DETAIL	A-B-C	
SCE	SECURITY SURVEILLANCE CCTV CAMERAS PLAN/LAYOUT/DETAIL	A-B-C	
SCE	AUTOMATED BARRIER PLAN/LAYOUT/DETAIL	A-B-C	
SCE	SECURITY EQUIPMENT ELECTRICAL PLAN/DETAIL/LAYOUT	A-B-C	
SPP = SECURITY PLOT PLAN PER = PERIMETER GAT = GATEHOUSE SCE = SECURITY EQUIPMENT			
INDEX 'P'			
CBL	CABLE ROUTING PLAN	A-B-C	
CBL	CABLE TRAY/RACEWAY PLAN/LAYOUT	A-B-C	
CBL	CABLE/CONDUIT LAYOUT	A-B-C	
CBL	CABLE/CONDUIT RACEWAY PLAN/LAYOUT	A-B-C	
CBL	CONDUIT & JUNCTION BOX ARRANGEMENT	A-B-C	
CBL	CONDUIT PLAN/DETAIL/INSTALLATION	A-B-C	
CBL	DUCT BANK/CABLE TRENCH LAYOUT	A-B-C	
CBL	GROUNDING PLAN/LAYOUT/DETAIL	A-B-C	
CBL	OVERHEAD POWER LINE LAYOUT	A-B-C-D	
CBL	SUBMARINE CABLE/UMBILICAL ALIGNMENT SHEET	A-B-C	
CCS	CABLE & CONDUIT SCHEDULE	D	
DAT	ELECTRICAL EQUIPMENT DATA SHEET	D-E	
E1L	ELECTRICAL ONE LINE DIAGRAM	A-B-C	
E1L	ELECTRICAL THREE LINE DIAGRAM	A-B-C	
ECD	ELECTRICAL CONNECTION/ INTERCONNECTION DIAGRAM	A-B-C	
EDT	ELECTRICAL PLAN/LAYOUT/DETAIL	A-B-C	
EDT	JUNCTION BOX ARRANGEMENT/DETAIL/ LAYOUT/ELEVATION	A-B-C	
ELM	ELEMENTARY DIAGRAM	A-B-C	
EPD	POWER DISTRIBUTION/WIRING DIAGRAM	A-B-C	
EPD	POWER PLAN/GROUNDING LAYOUT	A-B-C	
EWD	ELECTRICAL WIRING DIAGRAM	A-B-C	
LTG	LIGHTING PLAN/LAYOUT/DETAIL	A-B-C	
LTG	POWER LIGHTING LAYOUT/PLAN/DETAIL	A-B-C	
LTG	STREET LIGHTING LAYOUT/PLAN/DETAIL AREA LIGHTING	A-B-C	
MCC	ELEVATION/DETAIL MOTOR CONTROL CENTER	A-B-C	
PNL	PANEL LAYOUT/ARRANGEMENT/ DETAIL/SECTION	A-B-C	
RAK	RACK LAYOUT	A-B-C	
SCH	CABLE TRAY LOADING SCHEDULE	A-B-C-D	
SCH	ELECTRICAL LOAD TABULATION	A-B-C-D	
SCH	LIGHTING & POWER SCHEDULE	A-B-C-D	
SCH	PANEL SCHEDULE	B-C-D	
SCH	LIGHTING PANEL SCHEDULE	C-D	
SCH	STRUCTURAL LIST OVERHEAD POWER LINE	C-D	

DRAWING TYPE	DESCRIPTION	DRAWING SIZE	COMMENTS
SCM	SCHEMATIC DIAGRAM	A-B-C	
SWG	SWITCHGEAR ELEVATION/DETAIL/ SPECIFICATION/ARRANGEMENT	A-B-C	
TRM	TERMINAL LAYOUT	A-B-C	
INDEX 'Q'			
FDN	CONCRETE RETAINING WALL/SLEEPER (PLAN/LAYOUT/SECTION/DETAIL)	A-B-C-D	
FDN	FOUNDATION PLAN/LAYOUT/ SECTION/DETAIL	A-B-C-D	
FDN	SEWER MANHOLE PLAN/SECTION/DETAIL	A-B-C-D	
FDN	TRENCH LAYOUT/DETAIL	A-B-C-D	
FDN	VALVE BOX LAYOUT/SECTION/DETAIL	A-B-C-D	
STL	REBAR/REINFORCING BAR DETAIL	A-B-C-D	
STL	REBAR/REINFORCING BAR SCHEDULE	B-C-D	
STL	STEEL BENDING DETAIL	B-C-D	
INDEX 'R'			
ARC	BEAM SECTION/DETAIL	A-B-C-D	
ARC	DOOR/WINDOW DETAIL	A-B-C-D	
ARC	FLOOR PLAN	A-B-C	
ARC	INTERIOR/EXTERIOR FINISH DETAIL	A-B-C-D	
ARC	PERSPECTIVE VIEW	A-B-C-D	
ARC	PLAN/LAYOUT/ELEVATION/SECTION/DETAIL (CONCRETE & WOODEN FRAME BUILDINGS)	A-B-C-D	ARCHITECTURAL
ARC	ROOF FRAMING PLAN	A-B-C-D	
ARC	WALL SECTION/DETAIL	A-B-C-D	
EQA	EQUIPMENT LAYOUT/LEGEND	A-B-C-D	BUILDINGS
SCH	DOOR/WINDOW SCHEDULE	A-B-C-D	
SCH	SCHEDULE OF FINISHES/FURNISHING	A-B-C-D	
SDT	ROOF & CEILING PLAN/ELEVATION/SECTION	A-B-C-D	
INDEX 'S'			
GAP	BERMS PLAN/LOCATION/ELEVATION/ DETAILS	A-B-C	
GAP	GRADING/PAVING/EARTHWORK	A-B-C	
GAP	LANDSCAPING PLAN/LAYOUT/DETAIL	A-B-C	
GAP	MONUMENT REFERENCE	A-B-C	
GAP	ROAD CROSSING DETAILS	A-B-C	
GAP	ROADS/TRAFFIC ISLAND/PARKING LOT	A-B-C	
GAP	SITE DEVELOPMENT PLAN	A-B-C	
PLB	PLUMBING DRAIN/WASTE & VENT PIPING DETAIL/LAYOUT	A-B-C-D	
PLB	PLUMBING FLOOR PLAN	A-B-C-D	
PLB	PLUMBING PLAN/LAYOUT/DETAIL	A-B-C-D	
PLB	PLUMBING RISER DIAGRAM	A-B-C-D	
UTI	UTILITY ISOMETRIC PIPING DETAIL	A-B-C-D	
UTI	UTILITY PIPING ELEVATION/SECTION/DETAIL	A-B-C-D	
UTI	UTILITY PIPING PLAN/LAYOUT/ROUTING (RAW WATER/DRINKING WATER/FIREWATER / IRRIGATION/STEAM/SPRINKLER/GAS/ SEWER/DRAIN/WASTE/VENT)	A-B-C	

DRAWING TYPE	DESCRIPTION	DRAWING SIZE	COMMENTS
INDEX 'T'			
ANT	ANTENNA & FEEDER MOUNTING DETAILS	A-B-C	
ANT	ANTENNA & TOWER FOUNDATION	A-B-C	
ANT	ANTENNA & TRANSMISSION LINE LAYOUT	A-B-C	
ANT	ANTENNA & TOWER INSTALLATION DETAILS	A-B-C	
ANT	ANTENNA COMMUNICATION TOWER (PLAN/LAYOUT/ELEVATION/DETAIL)	A-B-C	
ANT	ANTENNA MOUNTING DETAILS	A-B-C	
ANT	TOWER FOUNDATION LAYOUT	A-B-C	
ANT	TRANSMISSION LINE LAYOUT	A-B-C	
ANT	WAVEGUIDE FEEDER BRIDGE/DETAILS	A-B-C	
CBL	(CONDUIT/CABLE) INSTALLATION LAYOUT/DETAILS	A-B-C	
CBL	CABLE & CONDUIT LAYOUT	A-B-C	
CBL	CABLE (RUNWAY/WAY) & STRUCTURES/DETAILS	A-B-C	
CBL	CABLE (TRAY/VAULT) RACKING DETAIL	A-B-C	
CBL	CABLE ENTRANCE DETAIL	A-B-C	
CBL	CABLE IDENTIFICATION	A-B-C	
CBL	CABLE PULLING & REEL SET-UP	A-B-C	
CBL	CABLE ROUTE (STRAIGHT LINE DIAGRAM/DC POWER SYSTEM/SOLAR ARRAY)	A-B-C	
CBL	CABLE SCHEMATIC LAYOUT/DETAIL	A-B-C	
CBL	CABLE SPLICING DETAILS	A-B-C	
CBL	CABLE TERMINATION	A-B-C	
CBL	CABLE TRAY LAYOUT/DETAIL	A-B-C	
CBL	CEILING CHANNEL SUPPORT	A-B-C	
CBL	CONDUIT ELEVATION & DETAILS	A-B-C	
CBL	CROSSING & MISCELLANEOUS DETAILS	A-B-C	
CBL	FIBER OPTIC BACKBONE DETAILS	A-B-C	
CBL	FIBER OPTIC BYPASS	A-B-C	
CBL	FIBER OPTIC TRUCK CABLE INSTALLATION	A-B-C	
CBL	GROUNDING PLAN (LAYOUT/DETAILS/MISC)	A-B-C	
CBL	HORIZONTAL DATA & VOICE CABLE WAY PLAN	A-B-C	
CBL	HORIZONTAL DATA & VOICE OUTLET	A-B-C	
CBL	MANHOLE & CONDUIT LAYOUT/DETAILS	A-B-C	
CBL	MANHOLE FOLDOUT/DETAILS	A-B-C	
CBL	EQUIPMENT & CABLE LAYOUT/DETAILS	A-B-C	
CBL	RADIO RF FEED LINE CABLE	A-B-C	
CBL	SUBDUCT INSTALLATION DETAIL	A-B-C	
CBL	TELEPHONE CABLE (PLAN/LAYOUT/ROUTING/DETAIL/ELEVATION)	A-B-C	
CBL	TELEPHONE FACILITY (PLAN/LAYOUT/ROUTING/DETAIL/ELEVATION)	A-B-C	
CBL	TELEPHONE LAYOUT/SWITCHING SYSTEM	A-B-C	
CBL	TRENCH LAYOUT (CABLE/CONDUIT)	A-B-C	
CCS	CABLE & CONDUIT SCHEDULE	D	

DRAWING TYPE	DESCRIPTION	DRAWING SIZE	COMMENTS
COM	CABLE & VIDEO SYSTEM, MATV, CCTV, PUBLIC ADDRESS SYSTEM, MICROWAVE SYSTEM, RADAR SYSTEM, VIDEO CONFERENCING, LAN, WIRELESS SYSTEM	A-B-C	
COM	CONNECTOR/INTERFACE DETAIL	A-B-C	
COM	GENERAL NOTES/LEGEND/ABBREVIATION	A-B-C	
DTA	DATA/VOICE COMMS FACILITIES	A-B-C	
DTA	DATA NETWORK	A-B-C	
DTA	VOICE/DATA SYSTEM LAYOUT	A-B-C	
ECD	CONNECTION/INTERCONNECTION DIAGRAM	A-B-C	
EDT	ELECTRICAL DETAILS (PLAN/LAYOUT/ASSEMBLY)	A-B-C	
EQA	EQUIPMENT LAYOUT/DETAIL/LOCATION	A-B-C	
EQA	EQUIPMENT/CONSOLE ARRANGEMENT	A-B-C	
EQD	EQUIPMENT ASSEMBLY (PLAN/DETAILS)	A-B-C	
EWD	ALARM DIAGRAM	A-B-C	
EWD	BLOCK & LEVEL DIAGRAM	A-B-C	
EWD	CIRCUIT DIAGRAM	A-B-C	
EWD	DC POWER DISTRIBUTION	A-B-C	
EWD	TELEPHONE/COMMS/DIGITAL SIGNAL WIRING	A-B-C	
EWD	WIRING DIAGRAM	A-B-C	
RAK	RACK FACE ELEVATION	A-B-C	
RAK	RACK INTERFACE DETAIL	A-B-C	
RAK	RACK LAYOUT	A-B-C	
RPF	RADIATION PROFILE	A-B-C	
RPF	RADIO COVERAGE	A-B-C	
RPF	RADIO PATH PROFILE	A-B-C	
SCH	CABLE RUNNING LIST	A-B-C	
SCH	CROSS-CONNECT WIRE SCHEDULE	A-B-C-D	
SCH	PANEL INTERCONNECTION SCHEDULE	A-B-C-D	
SCH	PANELBOARD LOAD SCHEDULE	A-B-C-D	
SCH	WIRING LIST	A-B-C	
SCH	WIRING TABLE	A-B-C	
SCM	BLOCK & LEVEL DIAGRAM	A-B-C	
SCM	CABLE IDENTIFICATION TABLE	A-B-C	
SCM	CIRCUIT DIAGRAM	A-B-C	
SCM	INTERCONNECTION WIRING DIAGRAM	A-B-C	
SCM	RISER DIAGRAM	A-B-C	
SCM	SCHEMATIC DIAGRAM	A-B-C	
SCM	SYSTEM BLOCK DIAGRAM	A-B-C	
INDEX 'U'			
ARC	HOSPITAL/LABORATORY/OFFICE (PLAN/LAYOUT)	A-B-C	
INDEX 'V'			
EQA	MARINE EQUIPMENTS	A-B-C	
INDEX 'X'			
CAT	ANODE BED DATA SCHEDULE	A-B-C-D	

DRAWING TYPE	DESCRIPTION	DRAWING SIZE	COMMENTS
CAT	ANODE BED IN-PLANT LOCATION PLAN	A-B-C	
CAT	ANODE BED LOCATION PLAN/LAYOUT/INSTALLATION/DETAIL	A-B-C-D	
CAT	BLOCK DIAGRAM ANODE BED	A-B-C-D	
CAT	CATHODIC PROTECTION PLAN/LAYOUT/DETAIL	A-B-C-D	
INDEX 'Z'			
DTA	DATA COMMUNICATIONS	A-B-C	
LOG	PROCESS COMPUTER TERMINAL MANAGEMENT	A-B-C	
MDF	DIGITAL DISTRIBUTION FRAME	A-B-C	
MDF	MAIN DISTRIBUTION FRAME	A-B-C	
MDF	MAIN/INTERMEDIATE DISTRIBUTION FRAME	A-B-C	
SCM	NETWORK CONFIGURATION	A-B-C	
SCM	NETWORK EQUIPMENT CONFIGURATION	A-B-C	

Appendix C – Saudi Aramco Borders and Seed Files

FORMS, SEED FILES AND BORDERS TABLE						
PRODUCT (Logical Name)	DWG. SIZE	FORM NO.	TITLE	SEED FILE NAME	BORDER FILE NAME	CADD VERSION
APP	B	2696	LAYOUT OF APPURTENANCES	2696.b	2696b03.bor	CADD-03
APP	C	2696-1	LAYOUT OF APPURTENANCES	2696.c	2696c00.bor	CADD-00
APP	D	2696-2	LAYOUT OF APPURTENANCES	2696.d	2696d00.bor	CADD-00
ARC	A	2615	ARCHITECTURAL & LANDSCAPING	arc.a	arca01.bor	CADD-01
ARC	B	2634	ARCHITECTURAL & LANDSCAPING	arc.b	arcb00.bor	CADD-00
ARC	C	2635	ARCHITECTURAL & LANDSCAPING	arc.c	arcc00.bor	CADD-00
ARC	D	2636	ARCHITECTURAL & LANDSCAPING	arc.d	arcd00.bor	CADD-00
CIV	A	2615	CIVIL & STRUCTURAL	civ.a	civa01.bor	CADD-01
CIV	B	2634	CIVIL & STRUCTURAL	civ.b	civb00.bor	CADD-00
CIV	C	2635	CIVIL & STRUCTURAL	civ.c	civc00.bor	CADD-00
CIV	D	2636	CIVIL & STRUCTURAL	civ.d	civd00.bor	CADD-00
COM	A	2615	COMMUNICATION	com.a	coma01.bor	CADD-01
COM	B	2634	COMMUNICATION	com.b	comb00.bor	CADD-00
COM	C	2635	COMMUNICATION	com.c	comc00.bor	CADD-00
COM	D	2636	COMMUNICATION	com.d	comd00.bor	CADD-00
DAT	D	9527	PRESSURE VESSEL DATA SHEET	9527.d	9527d02.bor	CADD-02
DEF	A	2615	STANDARD "A" SIZE	def.a	defa05.bor	CADD-05
DEF	B	2634	STANDARD "B" SIZE	def.b	defb05.bor	CADD-05
DEF	C	2635	STANDARD "C" SIZE	def.c	defc05.bor	CADD-05
DEF	D	2636	STANDARD "D" SIZE	def.d	defd04.bor	CADD-04
DEF	E	2616	STANDARD "E" SIZE	def.e	defe04.bor	CADD-04
E1L	A	2615	ELECTRICAL ONE LINE DIAGRAM	e1l.a	e1la05.bor	CADD-05
E1L	B	2634	ELECTRICAL ONE LINE DIAGRAM	e1l.b	e1lb00.bor	CADD-00
E1L	C	2635	ELECTRICAL ONE LINE DIAGRAM	e1l.c	e1lc00.bor	CADD-00
EDT	A	2615	MISCELLANEOUS ELECTRICAL	edt.a	edta01.bor	CADD-01
EDT	B	2634	MISCELLANEOUS ELECTRICAL	edt.b	edtb00.bor	CADD-00
EDT	C	2635	MISCELLANEOUS ELECTRICAL	edt.c	edtc00.bor	CADD-00
EQD	B	2527	EQUIPMENT ASSEMBLY AND DETAILS	2527.b	2527b03.bor	CADD-03
EQD	C	2527-1	EQUIPMENT ASSEMBLY AND DETAILS	2527.c	2527c00.bor	CADD-00
FPP	A	2615	FACILITY PLOT PLAN	fpp.a	fppa05.bor	CADD-05
FPP	B	2634	FACILITY PLOT PLAN	fpp.b	fppb00.bor	CADD-00
FPP	C	2635	FACILITY PLOT PLAN	fpp.c	fppc00.bor	CADD-00
FSH	A	2615-1	FACE SHEET	deffsh.a	2615-1a02.bor	CADD-02
FSH	B	2634-1	FACE SHEET	deffsh.b	2634-1b02.bor	CADD-02
FSH	C	2635-1	FACE SHEET	deffsh.c	2635-1c02.bor	CADD-02
FSH	D	2636-1	FACE SHEET	deffsh.d	2636-1d02.bor	CADD-02
FSH	E	2616-1	FACE SHEET	deffsh.e	2616-1e02.bor	CADD-02

FORMS, SEED FILES AND BORDERS TABLE						
PRODUCT (Logical Name)	DWG. SIZE	FORM NO.	TITLE	SEED FILE NAME	BORDER FILE NAME	CADD VERSION
GAT	A	2615	GATEHOUSE	def.a	defa05.bor	CADD-05
GAT	B	2634	GATEHOUSE	def.b	defb05.bor	CADD-05
GAT	C	2635	GATEHOUSE	def.c	defc05.bor	CADD-05
HVA	A	2615	HVAC	hva.a	hvaa01.bor	CADD-01
HVA	B	2634	HVAC	hva.b	hvac00.bor	CADD-00
HVA	C	2635	HVAC	hva.c	hvac00.bor	CADD-00
ILD	B	7460	INSTRUMENT LOOP DIAGRAM	ild.b	ildb05.bor	CADD-05
ILD	C	7460-1	INSTRUMENT LOOP DIAGRAM	ild.c	ildd00.bor	CADD-00
ILD	D	7460-2	INSTRUMENT LOOP DIAGRAM	ild.d	ildd00.bor	CADD-00
ILD	B	8111	INDEX SHEET INSTRUMENT LOOP DIAG.	8111.b	8111b03.bor	CADD-03
ILD	C	8111-1	INDEX SHEET INSTRUMENT LOOP DIAG.	8111.c	8111c00.bor	CADD-00
ILD	D	8111-2	INDEX SHEET INSTRUMENT LOOP DIAG.	8111.d	8111d00.bor	CADD-00
ISD	B	7460A	INSTRUMENT SEGMENT DIAGRAM	isd.b	isdb02.bor	CADD-02
ISO	B	2825	ISOMETRIC PIPING DETAIL	2825.b	2825b03.bor	CADD-03
ISO	C	2825-1	ISOMETRIC PIPING DETAIL	2825.c	2825c00.bor	CADD-00
ISO	D	2825-2	ISOMETRIC PIPING DETAIL	2825.d	2825d00.bor	CADD-00
LOG	A	8110	LOGIC DIAGRAM	8110.a	8110a03.bor	CADD-03
LOG	B	8110-1	LOGIC DIAGRAM	8110.b	8110b00.bor	CADD-00
LOG	C	8110-2	LOGIC DIAGRAM	8110.c	8110c00.bor	CADD-00
OSI	B	9872	ON-STREAM INSPECTION	9872.b	9872b00.bor	CADD-00
PER	A	2615	SECURITY FENCE	def.a	defa05.bor	CADD-05
PER	B	2634	SECURITY FENCE	def.b	defb05.bor	CADD-05
PER	C	2635	SECURITY FENCE	def.c	defc05.bor	CADD-05
PFD	A	2615	PROCESS FLOW DIAGRAM	pf.d.a	pfda05.bor	CADD-05
PFD	B	2634	PROCESS FLOW DIAGRAM	pf.d.b	pfdb00.bor	CADD-00
PFD	C	2635	PROCESS FLOW DIAGRAM	pf.d.c	pfdc00.bor	CADD-00
PFD	D	2636	PROCESS FLOW DIAGRAM	pf.d.d	pfdd00.bor	CADD-00
PID	A	5994	PIPING & INSTRUMENT DIAGRAM	pid.a	pida06.bor	CADD-06
PID	B	5994-1	PIPING & INSTRUMENT DIAGRAM	pid.b	pidb00.bor	CADD-00
PPL	A	2615	PIPING PLAN	ppl.a	ppla01.bor	CADD-01
PPL	B	2634	PIPING PLAN	ppl.b	pplb00.bor	CADD-00
PPL	C	2635	PIPING PLAN	ppl.c	pplc00.bor	CADD-00
PPL	D	2636	PIPING PLAN	ppl.d	ppld00.bor	CADD-00
PRF	A	6285	PLAN AND PROFILE	6285.a	6285a02.bor	CADD-02
SCE	A	2615	SECURITY EQUIPMENT	def.a	defa05.bor	CADD-05
SCE	B	2634	SECURITY EQUIPMENT	def.b	defb05.bor	CADD-05
SCE	C	2635	SECURITY EQUIPMENT	def.c	defc05.bor	CADD-05
SCH	C	6232	LIGHTING PANEL SCHEDULE	6232.c	6232c03.bor	CADD-03
SPP	A	2615	SECURITY PLOT PLAN	fpp.a	fppa05.bor	CADD-05
SPP	B	2634	SECURITY PLOT PLAN	fpp.b	fppb00.bor	CADD-00
STL	B	2871	STEEL BENDING DETAILS	2871.b	2871b03.bor	CADD-03

FORMS, SEED FILES AND BORDERS TABLE						
PRODUCT (Logical Name)	DWG. SIZE	FORM NO.	TITLE	SEED FILE NAME	BORDER FILE NAME	CADD VERSION
TAB	A	8114	ELECTRICAL LOAD TABULATION	8114.a	8114a03.bor	CADD-03
UTI	A	2615	PLUMBING & UTILITY	uti.a	utia01.bor	CADD-01
VOD	A	2615	VALVE OPERATING DIAGRAM	vod.a	voda05.bor	CADD-05

Appendix D – Data-Centric Piping and Instrumentation Diagram (P&ID) Specification

1. INTRODUCTION

This appendix defines the requirements for preparing the Data-Centric P&IDs for Saudi Aramco using the Data-Centric P&ID design software approved by Saudi Aramco. It is Contractor responsibility to request the approved Data-Centric P&ID design software name and version, database software name and version, and approved P&ID Template from EK&RD.

2. CONFLICTS AND DEVIATIONS

Any conflicts between this appendix and other applicable Saudi Aramco Engineering Standards (SAESs), Procedures (SAEPs), Materials System Specifications (SAMSSs) and Standard Drawings (SASDs) shall be resolved in writing with EK&RD.

3. REFERENCES

Refer to applicable Saudi Aramco Engineering Standards (SAESs), Procedures (SAEPs), Materials System Specifications (SAMSSs), and Standard Drawings (SASDs).

4. SCOPE

4.1 General

- 4.1.1 Contractor shall follow this appendix as the basis for preparing Data-Centric P&IDs and PFDs. Included in this appendix are the requirements, guidelines, list of deliverables, the minimum data to be populated in the database and the requirements for Project delivery to EK&RD.
- 4.1.2 When requested, EK&RD will provide Contractor the Data-Centric P&ID Template comprising Reference Data and Data Dictionary, which shall be used for the database set-up and P&ID creation. It is presumed that the Data-Centric P&ID Template provided may not be comprehensive enough for any specific project and modifications/additions to it will be required in order to meet project requirements.
- 4.1.3 Use of the Data-Centric P&ID Template does not release the engineering contractor from the responsibility of submitting the Data-Centric P&ID deliverables meeting COMPANY

requirements, as defined in Section 3 of this standard.

- 4.1.4 All changes and/or additions to the Reference Data and Data Dictionary must be documented and submitted to EK&RD for approval, prior to use. Refer to [Attachment 4](#) for a sample issue log to be used for requesting any customization or clarification during the project.
- 4.1.5 The document with descriptive list of changes and additions as mentioned above, with EK&RD approval shall be included as part of deliverables, which are defined later in this appendix.
- 4.1.6 The Data-Centric P&IDs shall be submitted to Saudi Aramco as per *Section 16.11* of SAEP-334.
- 4.1.7 The final Data-Centric database delivered to Saudi Aramco shall have all the drawings and data in 'As-built' stage.
- 4.1.8 Contractor shall upgrade the database to conform to the latest approved Data-Centric P&ID version at the time of final delivery.
- 4.1.9 Contractor shall provide to EK&RD the Data-Centric P&ID project data as well as all supporting documentation.
- 4.1.10 The final Data-Centric P&ID delivery shall be one combined (merged/consolidated) database for the entire project/facility, regardless whether one or multiple contractors are working on the project.

4.2 Reference Data & Data Dictionary customizations

- 4.2.1 The Reference Data within the Data-Centric P&ID Template consists of:
 - Approved Symbols
 - COMPANY approved P&ID Borders
 - Rule File
 - Format File
 - Insulation Specification File
 - 4.2.2 The Data Dictionary template within the Data-Centric P&ID Template consists of:
 - Data Attributes (Properties)
 - Select Lists
-

- 4.2.3 It is COMPANY direction to use delivered ANSI/ISA standard Reference Data to the maximum extent possible for P&ID production. Additional symbols shall be defined by the contractor as required, but must be approved by the COMPANY prior to use on the project.
- 4.2.4 Any additional attributes, select lists and select list entries, which do not exist in the Data Dictionary and are required by the project, shall be created by the contractor and get them approved by EK&RD prior to use.
- 4.2.5 Forms, templates, rules and insulation specs customization shall be done by the contractor as required with prior approval from EK&RD.
- 4.2.6 Additional forms and documents created by the contractor shall adhere to the requirements specified in this standard and must be approved by EK&RD prior to use in the project.

4.3 **Quality Assurance**

- 4.3.1 All inconsistencies indications must be resolved in the P&IDs. Any inconsistency that can't be resolved shall be documented and submitted to Saudi Aramco for approval.
- 4.3.2 Check List in Attachment 2 of this appendix shall be followed while creating the P&IDs.
- 4.3.3 Symbols (based on ANSI & ISA), fonts and rules approved by EK&RD shall be used for the creation of P&IDs.
- 4.3.4 All Drawings and Reports submitted to EK&RD shall have customized title block as per [Section 6](#) of this standard.
- 4.3.5 The latest Saudi Aramco border file available at project commencement shall be used.
- 4.3.6 Arial Font shall be used for all textual elements of the drawing.

5. Data-Centric P&ID SET-UP

5.1 General

- 5.1.1 Latest versions approved by Saudi Aramco shall be used. Prior approval of EK&RD shall be obtained for using other versions of the Data-Centric P&ID software. Contractor shall use the database software and version approved by Saudi Aramco and compatible with the approved Data-Centric P&ID software.
- 5.1.2 The final submittal of the Data-Centric P&ID shall be upgraded to the latest approved version by EK&RD at the time of submittal.
- 5.1.3 The Data-Centric P&ID Template provided by EK&RD shall be used while setting up the Data-Centric P&ID Project.

5.2 Data-Centric P&ID Set-up

The Data-Centric P&ID project shall be created and configured as follows:

Name:	<i>Facility Name</i>
Database Type:	approved database
Data Storage Name:	TS_XXX_DATA_01*
Temporary Storage Name:	TEMP_XXX*
Database User Name:	XXXSITE*
Database Password:	XXXSITE123*

* Where XXX = Plant\Org abbreviation from iPlant, "e.g., HGP for Hawiyah Gas Plant"

5.3 Plant Set-up

- 5.3.1 See Attachment 3 of this appendix for a sample of the list of Plants, Units, and Areas and their associated data. This shall be prepared by the plant owner (proponent).
- 5.3.2 Plant Setup shall be defined and configured as follows:

Template Path	<i>Company Template path</i>
Hierarchy	Plant/Area/Unit
Plant Name	<i>Facility Name</i>
Format File location	<i>Company Reference Data path</i>
Database Storage Name	TS_XXX_DATA_01*
Temp Database Storage Name	TEMP_XXX*
Database Username	XXXPLANT*

Database Password	XXXPLANT123*
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* Where XXX = Plant\Org abbreviation from iPlant, "e.g., HGP for Hawiyah Gas Plant"

5.3.3 Following table lists the required data for each plant (Facility Name):

Description	Value
Name	
Description	

5.4 Data-Centric P&ID Application Association

When establishing Application Association, the following configuration shall be followed:

P&ID Reference Data path	Company Reference Data path
Data Dictionary Source	Use Custom Template
Template Path	Company Data Dictionary path
Database Storage Name	TS_XXX_DATA_01
Temp Database Storage Name	TEMP_XXX
Database Username	XXXPLANTPID
Database Password	XXXPLANTPID123

* Where XXX = Plant\Org abbreviation from iPlant, "e.g., HGP for Hawiyah Gas Plant"

5.5 Plant Hierarchy Structure

5.3.1 The project plant structure must be Plant/Area/Unit.

5.3.2 All drawings shall be created at the Unit level only.

5.3.3 The following shall be applied to all project data:

5.3.3.1 Plant shall be *the Facility Name*

5.3.3.2 Area shall be the plant number (As created in iPlant).

For example: Plant number "H46" in Hawiyah Gas Plant

5.3.3.3 Unit number and Unit Code shall be the unit as created in iPlant

Where www = the unit number, “e.g., unit 100 for Hawiyah Gas Plant under plant number H46”

5.3.4 Following tables list the required data:

Plant

Description	Data entry	Value
Plant Name	Yes	iPlant Facility Name
Description	Yes	iPlant Facility Name

Area

Description	Data entry	Value
Area Name	Yes	iPlant Plant number
Description	Yes	iPlant Area Location

Unit

Description	Data entry	Value
Unit Name	Yes	iPlant Unit number
Unit Description	Yes	iPlant Description
Unit Code	Yes	iPlant Unit number

5.3.5 See Attachment 3 of this appendix for a sample of the list of the Plants, Areas, and Units and their associated data for the XXX Project. This list shall be prepared by the proponent.

6. NAMING CONVENTIONS

6.1 Drawing Naming Convention

P&ID drawing name property shall comply with [Section 5](#) (Drawing Name) of this standard and drawing number property shall comply with [Section 6](#) (Title Block Information) of this standard.

6.2 Pipe Run Tag Naming Convention

All pipe tags shall be according to [Section 10](#) of this standard.

Example: 2-1/2”-CWS-1234-1CS1P1

The pipe tag mapping to the equivalent properties is as shown below:

Property	Property Type	Example
Nominal Diameter	Select list	2-1/2”

Fluid Code	Select List	CWS
Tag Seq No	Integer	1234
Piping Materials Class	String	1CS1P

6.3 Equipment Tag Naming Convention

All equipment tags shall be according to [Section 10](#) of this standard.

Example: D31-GM-0012A

The equipment tag mapping to the equivalent properties is as shown below:

Property	Property Type	Example
Plant Number	String	D31
Tag Prefix	String	G
Tag Seq No	Integer	0012
Tag Suffix	String	A (When Applicable)

6.4 Instrument and Loop Tag Naming Convention

6.4.1 All loop tags shall be according to [Section 10](#) of this standard.

Example: K84-100-P-0012

The loop tag mapping to the equivalent properties is as shown below:

Property	Property Type	Example
Plant Number	String	K84
Unit Name	String	100
Loop Function	String	P
Tag Seq No	Integer	0012

6.4.2 All instrument tags shall be according to [Section 10](#) of this standard:

Example: K84-100-PIT-0012A

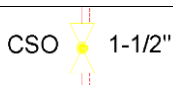
The instrument tag mapping to the equivalent properties is as shown below:

Property	Property Type	Example
Plant Number	String	K84
Unit Name	String	100
Measured Variable Code	String	P
Inst Type Modifier	String	IT
Tag Seq No	Integer	0012
Tag Suffix	String	A(When Applicable)


All instruments shall be assigned to loops.

7. P&ID Labels

7.1 Piping Component Labels

Piping Components - Valves	
	
Label Name	Nominal Diameter & Opening Action
Category	Piping
Detailed Label	Piping Components

Piping Components - Reducers	
6"x2"	
Label Name	Red Nominal Diameter
Category	Piping
Detailed Label	Piping Components

Piping OPC's	
 <p>FROM UTILITY BOILERS</p>	
Label Name	Off-Drawing_1From\To attributes shall be entered and displayed for each OPC
Category	
Detailed Label	

7.2 Equipment Description Labels

Equipment Detailed or Description Labels are placed on the top or the bottom of the P&ID. The delivered equipment descriptive labels with Saudi Aramco reference data shall be used to the maximum extent unless addition is required by the projects. The following are examples and not limitations.


Vessels	
<p><u>ZZZ-D-402B</u> OIL SEPARATOR SIZE : 1219.0 mm OD X 2593.0 mm T-T DESIGN : 325.0 psi-g AT 300 F/FULL VACUUM AT/370 F MATERIAL : CARBON STEEL</p>	
Label Name	Vessel Description
Category	Equipment
Detailed Label	Labels Equipment

Pumps	
<p><u>ZZZ-G-309A/B</u> WASH TOWER CIRCULATING PUMP RATED CAPACITY : 819.0 m³/s DIFF PRESSURE : 108.0 psi SG AT PT : 1.000 AT 112 F DRIVER HP : 100 HP</p>	
Label Name	Pump Description
Category	Equipment
Detailed Label	Labels Equipment

Heat Exchangers	
<p><u>ZZZ-E-349A</u> PLATFORMATE RUNDOWN TRIM COOLER DUTY : 435 MM BTU/HR DESIGN, SH : 160.0 psig AT 485 F AND HALF VACUUM AT 370 F DESIGN, TB : 120.0 psig AT 305 F SHELL MATERIAL : CARBON STEEL TUBE MATERIAL : 70-30 Cu-Ni</p>	
Label Name	Heat Exchanger Description
Category	Equipment
Detailed Label	Labels Equipment

Compressors	
<p style="text-align: center;"><u>ZZZ-K-401A</u> SCREW COMPRESSOR CAPACITY : DIFF PRESSURE : DRIVER HP :1750 HP</p>	
Label Name	Compressor Description
Category	Equipment
Detailed Label	Labels Equipment
Drivers	
<p style="text-align: center;"><u>ZZZ-GT-304A</u> DEBUTANIZER OVERHEAD PUMP TURBINE STEAM RATE : 13500 LBS/HR HP AT RPM : 127 BHP AT 3600.0 rpm</p>	
Label Name	Driver Description
Category	Equipment
Detailed Label	Labels Equipment

7.3 Instrument Label

Instruments	
	
Label Name	Embedded with the Instrument Symbol "Tag number with balloon"
Category	Instrumentation
Detailed Label	Labels - General Instrument

7.4 Pipe Run Label

Pipe Run	
<p style="text-align: center;"><u>1"-P-1234-6SA0P</u></p>	
Label Name	Line No wo Insulation
Category	Pipe Run
Detailed Label	Labels Piping Segments

8. REQUIRED ATTRIBUTES

8.1 Equipment Attributes

The following table lists all the required attributes or properties which shall be filled in the Data-Centric database for all equipment. Other attributes may be filled or used as per the project requirements:

EQUIPMENT	DRAWING INDEX	EQUIPMENT MARKING	REQUIRED FIELDS
VESSELS	D	D	Internal Diameter
			Length T-T
			Capacity
			Maximum Design Pressure
			Maximum Design Temperature
			Maximum Operating Pressure
			Maximum Operating Temperature
			Trim
DRUMS	D	D	Internal Diameter
			Length T-T
			Capacity
			Maximum Design Pressure
			Maximum Design Temperature
			Maximum Operating Pressure
			Maximum Operating Temperature
			Trim
TANKS	D	D	Length
			Width
			Height
			Capacity
			Maximum Design Pressure
			Maximum Design Temperature
			Maximum Operating Pressure
			Maximum Operating Temperature
PUMPS	G	G	Capacity
			Differential Pressure
			Driver Power
			Trim
GEAR UNIT	G	GG	Define as per project requirements
HYDRAULIC COUPLING	G	GH	Define as per project requirements
ELECTRIC MOTOR DRIVER	P	GM	Driver Power
			Speed
			Frequency
			Voltage
TURBINE DRIVER	K	GT	Phase
			Define as per project requirements
DIESEL ENGINE DRIVER	K	GD	Define as per project requirements
COMPRESSORS	K	K	Capacity

EQUIPMENT	DRAWING INDEX	EQUIPMENT MARKING	REQUIRED FIELDS
			Differential Pressure
			Discharge Pressure
			Maximum Design Pressure
			Maximum Design Temperature
			Trim
GEAR UNIT	K	KG	Define as per project requirements
HYDRAULIC COUPLING	K	KH	Define as per project requirements
ELECTRIC MOTOR DRIVER	P	KM	Driver Power
			Speed
			Frequency
			Voltage
			Phase
TURBINE DRIVER	K	KT	Define as per project requirements
DIESEL ENGINE DRIVER	K	KD	Define as per project requirements
CENTRIFUGE	K	KC	Define as per project requirements
VACUUM PUMPS	K	K	Define as per project requirements
MIXERS	K	K	Define as per project requirements
GENERATORS	P	P	Define as per project requirements
DIESEL ENGINE DRIVER	K	PD	Define as per project requirements
TURBINE DRIVER	K	PT	Define as per project requirements
HEAT EXCHANGERS	E	E	Duty
			Surface Area
			Maximum Design Pressure
			Maximum Design Temperature
			Maximum Operating Pressure
			Maximum Operating Temperature
			Trim
EXCHANGER FIN FAN	E	E	Define as per project requirements
EXCHANGER FIN FAN GEARBOX	E	EG	Define as per project requirements
EXCHANGER FIN FAN MOTOR	E	EM	Driver Power
			Speed
			Frequency
			Voltage
			Phase
EXCHANGER (TUBE/SHELL)	E	E	Duty
			Surface Area
			Shell Maximum Design Pressure
			Shell Maximum Design Temperature
			Shell Maximum Operating Pressure
			Shell Maximum Operating Temperature
			Shell Trim
			Tube Maximum Design Pressure
			Tube Maximum Design Temperature
			Tube Maximum Operating Pressure

EQUIPMENT	DRAWING INDEX	EQUIPMENT MARKING	REQUIRED FIELDS
			Tube Maximum Operating Temperature
			Tube Trim
BOILERS	F	F	Internal Diameter
			Maximum Design Pressure
			Maximum Design Temperature
			Maximum Operating Pressure
			Maximum Operating Temperature
COLUMNS	C	C	Internal Diameter
			Length T-T
			Capacity
			Maximum Design Pressure
			Maximum Design Temperature
			Maximum Operating Pressure
			Maximum Operating Temperature
			Trim
SPECIAL EQUIPMENTS	U	U	Define as per project requirements
JIB CRANE	M	U	Define as per project requirements
ESCAPE CAPSULE	U	U	Define as per project requirements

8.2 Instrument Attributes

The following table lists the required attribute or properties that are required to be filed for each instrument type. Other attributes may be filled or used as per the project requirements.

		Set Point		Range	
Pressure	Instrument Type	Pressure High	Pressure Low	Pressure High	Pressure Low
	PZV	√	X	X	X
	PCV	√	X	X	X
	PI "Field Inst."	X	X	√	√
	PI "DCS Inst."	√	√	X	X
	PDT	√	√	√	√
	PIT	√	√	√	√
	PT	√	√	√	√
	PA	√	√	X	X
	PIC	√	√	√	√
Temperature	Instrument Type	Temperature High	Temperature Low	Temperature High	Temperature Low
	TI "Field Inst."	X	X	√	√
	TI "DCS Inst."	√	√	X	X
	TIC	√	√	√	√
	TIT	√	√	√	√
Flow	Instrument Type	Flow High	Flow Low	Flow High	Flow Low
	FI "Field Inst."	X	X	√	√

		Set Point		Range	
	FI "DCS Inst."	√	√	X	X
	FIC	√	√	√	√
	FIT	√	√	√	√
	FT	√	√	√	√
Level	Instrument Type	Level High	Level Low	Level High	Level Low
	LG	X	X	√	√
	LT	√	√	√	√
	LI "Field Inst."	X	X	√	√
	LI "DCS Inst."	√	√	X	X
	LIT	√	√	√	√
	LIC	√	√	√	√

Note: √ means required

X means optional

9. DATA HANDOVER

9.1 Pre-Project Enabled Data-Centric P&ID plant backup

A complete Data-Centric P&ID plant backup shall be generated before enabling the project environment including the P&ID Reference Data (symbols, templates, assemblies, report templates, rules, insulation spec, modified dlls, etc.) used in the Data-Centric P&ID creation.

9.2 Post-Project Enabled Data-Centric P&ID plant backup

A complete Data-Centric P&ID plant backup in As-built stage after enabling the project environment including the P&ID Reference Data (symbols, templates, assemblies, report templates, rules, insulation spec, modified dlls, etc...) used in the Data-Centric P&ID creation.

9.3 Deviations Compliance Table

Compliance table highlighting all approved deviations from this appendix shall be delivered.

9.4 Customizations Approval Package

Document specifying customizations carried out in reference data, symbols, data dictionary, formats, rules, and reports along with their approvals.

9.5 Modified Code Package

Contractor shall highlight the modified versus delivered code for any modified DLL source code that were created for the Data-Centric P&ID project.

9.6 P&ID PDF Drawings Package

PDF files of all the P&IDs as generated from Data-Centric P&ID.

9.7 P&ID Hard Copy Package

Hard copy of all the P&IDs as generated from Data-Centric P&ID.

- 9.8 Data-Centric P&ID submittal form shall be delivered with every submittal. It shall contain complete information about the delivery and list of all generated drawings.

10. DATA HANDOVER QUALITY REQUIREMENTS**10.1 Drawings**

- 10.1.1 All the P&IDs in the Data-Centric P&ID database must be As-built before the final delivery.
- 10.1.2 Forced recreation must be successfully applied to all the drawings before the final delivery.
- 10.1.3 Prior to generating the Data-Centric P&ID Backup, CONTRACTOR shall cleanup any reported exceptions and submit error-free reports from the Data-Centric P&ID software.

10.2 Project

- 10.2.1 Prior to database delivery, all subprojects must be collapsed and deleted.
- 10.2.2 All temporary drawings, test drawings, test symbols and assemblies, test units, temporary filters, reports, etc. must be removed from the Data-Centric P&ID database before delivery.
- 10.2.3 Data-Centric P&ID database must be free of any database exceptions and orphan entries. The applicable Data-Centric P&ID utilities shall be run to clean up all database exceptions.
- 10.2.4 Contractor shall upgrade the Data-Centric P&ID database to the latest approved version at the time of delivery.
- 10.2.5 All the revisions or versions that are created during the design stages shall be deleted.

Attachment 1 - Title Block

Title Block Field Name	Display Name	Remarks
PLANT NO	Area Name	
INDEX	Drawing Index	
DRAWING NUMBER	Drawing Number	
SHT. NO.	Sheet No	
REV.NO.	Revision	Must match title block revision
Location	Area Description	
Drawing Title - Line 1	Hard Coded	
Drawing Title - Line 2	Description	
Drawing Title - Line 3	Unit Description	
DRAWING TYPE	Hard Coded	
JOB ORDER/EWO NO.	Job Order EWO No	
Revision DATE	Rev Date	
REVISION DESCRIPTION	Rev Desc	
Design Certification: ENGG.	Engineering By	
Design Certification: DATE	Engineering Date	
Design Certification: CERTIFIED BY	Certified By	
Design Certification: CERTIFIED DATE	Certified Date	
Review: CONST. AGENCY	Construction Agency	
Review: CONST. DATE	Construction Agency Date	
Review: OPERATIONS	Operations	
Review: OPERATIONS DATE	Operations Date	
Other: BY	Other	
Other: DATE	Other Date	
Key Drawings Review: REQUIRED	Hard Coded	
DCC Number	DCC No	
EMERGENCY DRAWING	Emergency Drawing	
Drawing Sensitivity	Drawing Confidentiality	
Drawing File Format Type	Hard Coded	

Reference Drawings

Title Block Field Name	Display Name	Remarks
Reference Drawing 1_No	Reference Drawing No 1	
Reference Drawing 2_No	Reference Drawing No 2	
Reference Drawing 3_No	Reference Drawing No 3	
Reference Drawing 4_No	Reference Drawing No 4	
Reference Drawing 5_No	Reference Drawing No 5	
Reference Drawing 6_No	Reference Drawing No 6	
Reference Drawing 7_Desc	Reference Drawing Desc 7	
Reference Drawing 7_No	Reference Drawing No 7	
Reference Drawing 7_Desc	Reference Drawing Desc 8	
Reference Drawing 7_No	Reference Drawing No 8	

Drawing Note

Title Block Field Name	Display Name	Remarks
NOTES	Drawing Notes	

Attachment 2 – P&ID Quality Assurance Check Lists

General Check List	
1	The Special character apostrophe ' shall not be used to comment values of any attributes with unit of measure. i.e., united attribute values shall not be commented.
2	Tags and associated data shall be entered in consistent manner as defined by this specification.
3	Saudi Aramco Abbreviation conventions shall be followed as per SAES.
4	Comments must be placed using Annotation Symbols.
5	Dumb text shall be used only with EK&RD approval. Dumb labels used shall be documented.
6	All symbols shall be parametric. Customized symbols shall be pre-approved.
7	All symbols shall have Class and Sub-class defined.
8	The naming convention of the new symbols or labels shall be similar to the Saudi Aramco customized labels. The symbol name shall be descriptive where it represents the symbol name.

Drawing Check List	
1	Drawing title block entries must follow this standard and have corresponding user-defined attributes as defined in this appendix.
2	P&ID detail sketches shall be placed as intelligent items or Auxiliary Graphics.
3	Nothing shall be placed outside the drawing border.
4	Only approved Saudi Aramco Data-Centric P&ID templates shall be linked with drawings.
5	No P&IDs shall have any information, except border as a linked document, intelligent labels, intelligent symbols and auxiliary graphics. The forced re-creation of P&ID (with P&ID file renamed) must fetch the P&ID from the database without any loss of information.

Equipment Check List	
1	All Equipment shall be TAGGED
2	Equipment Name Attribute shall be defined for all the equipment.
3	All applicable data attributes must be filled to the fullest extent in accordance with SAES.
4	Package equipment shall have full equipment features shown on the main plant P&ID along with all instrumentation and shall not be shown as a 'Black Box'
5	Equipment Class shall be the selection criteria for placement.
6	In cases where a single equipment-graphic is displayed on the face of the drawing and the equipment labels indicate existence of multiple equipment, multiple equipment graphics shall be placed as overlapped graphics. All the required attributes shall be populated for all the overlapped equipment.
7	In cases where data for multiple equipment of same category are displayed in single label, e.g., E-11150 A/B/C the label is to be placed selecting E-11150A and the tag suffix label is to be used to place the labels for remaining equipment.
8	Equipment Tag Prefix, Tag Sequence Number, Tag Suffix, etc. shall be entered properly for each equipment. Use of space or other characters to overcome the Duplicate Tag situation is not acceptable.
9	Equipment label shall be standardized. If the Data-Centric P&ID doesn't have requisite properties, they shall be added, but with prior approval from EK&RD. If labels have units that are not available in the Data-Centric P&ID, a new label shall be created with the right unit.
10	All new Equipment symbols shall be customized as Parametric.
11	Prior approval shall be obtained for the customization of Equipment Descriptions labels with more information, than in the available labels.
12	The Equipment level labels like HHLL (High High Liquid Level), LLL (Low Liquid Level) in the Data-Centric P&ID corresponds to HHL, LL in the source P&ID.
13	Multiple representations can be used in cases where the equipment is displayed in multiple drawings.

Instrument Check List	
1	All Instruments must be TAGGED
2	All applicable instrument data-attributes must be filled in to the fullest extent possible.
3	Instrument Loops shall be created.
4	Instrument Loop must be defined for all the instruments
5	Instrument Measured Variable Code, Instrument Type Modifier, Instrument Tag Sequence Number and Instrument Tag Suffix to be entered properly for every Instrument.
6	All instruments that do not appear in any pipeline are to be placed offline.
7	Offline Instruments with implied components shall not be used.
8	All Inline instruments shall have the tag number represented on the P&ID as balloon.
9	Use signal point for instruments having RUN, CLOSED, FAH, FAL, START, STOP, RUNNING, LAH, etc.
10	Set points must be defined for all DCS instruments. Set Point labels must be used to display the set point value on the face of the P&ID. Pressure High & Pressure Low attributes shall be used to represent high & low set points and similarly for Temperature, Flow, Level, etc.
11	The following format shall be used to represent instrument set point on the face of the P&ID: <ul style="list-style-type: none"> • H Set @ High Unit • L Set @ Low Unit
12	Instrument Range must be defined for all field instruments. Instrument range labels must be used to display the range value on the face of the P&ID. Pressure High & Pressure Low attributes shall be used to represent instrument range and similarly for Temperature, Flow, Level, etc.
13	The following format shall be used to represent instrument range on the face of the P&ID: <ul style="list-style-type: none"> • Low - High unit
14	TSO for control valve shall be put as Option code label NC for control valve shall be put as Opening Action label. FC for control valve shall be put as Fail Action label.
15	Instrument Control Case shall not be used to represent the high and low values for instrument range and set points
16	Rating Ratio Label shall be used to represent the rating ratio for the control valve.
17	ISA standard shall be used to represent the Signal Line on the face of the P&ID.
18	All the instruments which are listed in a Table within the P&ID drawing must be represented as an intelligent instrument, "i.e., an instrument symbol that represent the Tag Number without any graphical representation shall be placed in the table". This type of instruments shall be defined in the right category with correct class and subclass and the appropriate symbol shall be placed on the drawing.


Pipe Run Check List	
1	All Pipe Runs must be TAGGED
2	All applicable pipe-run data attributes must be filled in to the fullest extent possible.
3	Pipe Run shall be placed as continuous line, "i.e., segmented or fragmented pipe run for the same tag are not allowed". (<i>exception: Equipment trim</i>)
4	Pipe runs to be placed as straight runs & care shall be taken to eliminate unwanted 'steps / vertices' in straight pipe run.
5	Primary Piping to be placed for Lines with Fluid Code P and Secondary Piping for other fluid codes.
6	Proper Flow Direction shall be defined for all the pipe runs.
7	Pipe Line material class and Pipe class service/fluid codes shall comply with SAES-L-105
8	All the Pipe Runs must have the full information Nominal Diameter, Fluid Code, Tag Sequence Number and Piping Material Class.
9	Pipe run properties shall be propagated to all the pipe run branches, unless otherwise specified.
10	Insulation and PMC shall be passed from pipe run to nozzle, but if equipment has different Insulation than the nozzle, then the equipment insulation shall be passed to the nozzle & segment break shall be placed between piping flange & the nozzle.
11	Pipe Run Labels for horizontal lines to be placed above it and for vertical lines it has to be on left side. Leader line can be placed for Pipe Run Label if it cannot be placed as mentioned above due to space restrictions
12	An appropriate segment break label shall be used where it is required, "i.e. placing a group break label where only nominal diameter break is required is not acceptable.
13	All piping labels shall be aligned properly.
14	Use Flange Blind without Tap to represent blind flange. 'Flange Blind' symbol is used only when some tapping is required.
15	End 1 Nominal Diameter shall be greater than the End 2 Nominal Diameter for Reducers and Flange Reducing.
16	Flanges are to be placed on either side of the Pipe run crossing the Area Break / Package. Package Item Tag shall be given to Area break & propagated to all the components within the Area Break / Package boundary.
17	Description label to be used to represent the V (Vent), D (Drain) for valves.
18	Rating label shall be used to represent the Rating for piping components (e.g., 300#).
19	Pipe Run continuation referencing other P&IDs must be appropriately defined as an intelligent OPC "Off Page Connector". OPC pairs must be connected to the same pipe run, "i.e., same tag number"
20	All the OPC's must be connected.

Attachment 3 – Plants/Areas/Units

The following table shows an example of the Plant hierarchy that will be prepared by the proponent. Plant – Area - Unit for the XXX project

Facility Name	Area Name	Area Description	Unit Number	Unit Description
Hawiyah Gas Plant	H46	HAWIYAH	20	INLET AREA FACILITY

Attachment 4 – Sample Issue Log

	1	2	3	4	5	6	7	8	9	10
1	Issue Log									
2										
3	Ref No.	Drawing Number	Issue Description	Date of issue	Image	Contractor Proposed solution	Aramco Solution	Date of resolution	OPEN / CLOSE	Remarks
4	1	DA-123456001 Example Only	This type of pneumatic 3-way valve is not available.	01/01/2010		Create new	Create a symbol under Symbol Instrumentation In-Line Valves 3 Way 3 Way Generic Body_3_Closed.sym	1/2/2010		Example Only
5										
6										



Appendix E – Data Centric 3D Model Specification

1. INTRODUCTION

This appendix defines the requirements for preparing the 3D Models and related Data-Centric Engineering Drawings for Saudi Aramco using the 3D design software approved by Saudi Aramco. It is Contractor responsibility to request the approved Data-Centric 3D design software name and version, database software name and version, and the approved 3D Template from EK&RD.

2. CONFLICTS AND DEVIATIONS

Any conflicts between this appendix and other applicable Saudi Aramco Engineering Standards (SAESs), Procedures (SAEPs), Materials System Specifications (SAMSSs) and Standard Drawings (SASDs) shall be resolved in writing with EK&RD.

3. REFERENCES

Refer to applicable Saudi Aramco Engineering Standards (SAESs), Procedures (SAEPs), Materials System Specifications (SAMSSs) and Standard Drawings (SASDs).

4. SCOPE

- 4.1 Contractor shall follow this appendix as the basis for 3D modeling and generating the applicable drawings, as listed in Section 8 of this appendix, using the approved 3D software by Saudi Aramco.
- 4.2 This appendix defines the software version, project set up, guidelines for modeling, the minimum data to be populated in the database and the types of drawings to be generated.
- 4.3 Contractor shall carry out the necessary customizations required for modeling and subsequent drawing generation.
- 4.4 The technical contents of the engineering drawings including engineering data properties, attachments and any other engineering information related to piping, equipment, structural, instrumentation, electrical cable trays shall follow SAESs and SAEPs.
- 4.5 All Drawings & Reports submitted to Saudi Aramco shall have customized title block as per [Section 6](#) of this standard.
- 4.6 The drawings generated using the approved software shall be submitted to Saudi Aramco as per *Section 16.2* of SAEP-334.

- 4.7 The project delivery to Saudi Aramco shall be done according to this appendix.
- 4.8 The final Project backup delivered to EK&RD shall have all the models and related drawings in 'As-built' stage.
- 4.9 Contractor shall upgrade the 3D model to the latest versions of the Data-Centric 3D software and database approved Saudi Aramco at the time of final delivery.



5. PROJECT SET-UP FOR 3D MODELING

5.1 General

5.1.1 It is Contractor responsibility to request the approved Data-Centric 3D Design software name and version, database name and version, and the 3D Database Template from EK&RD.

5.1.2 Contractor shall perform the project setup as per this appendix.

5.2 Project Set up

A project is the fundamental structure for working in 3D modeling software; each project contains all the information required to work.

Design Contractor shall consult with EK&RD before setting up the specific project hierarchy and naming conventions.

5.2.1 The project plant structure must comply with Hierarchy "Plant/Area/Unit." as defined in iPlant.

- Plant shall be *Saudi Aramco's Facility Abbreviation (e.g., HGP, KGP). Its description shall be the facility name (e.g., "Hawiyah Gas Plant" for HGP)*
- Area shall be Saudi Aramco's Plant Name (e.g., X89, H46)
- Unit shall be Saudi Aramco's Unit Name (e.g., 611, 010)

5.2.2. The Project, Design Area and Model Naming conventions, criteria for deciding the Design Area and models are defined below.

When initializing the project, contractor shall use the following, as applicable:

Project Name: This shall be the facility name, e.g., HGP or KGP, if the entire Plants under this facility are covered in a single project. Project naming shall be coordinated with EK&RD.

Project Description: A brief description such as Khursaniyah Gas Plant Project, Hawiyah Gas Plant Project, etc.

Company/Owner: Saudi Aramco

Site: BI Number

Plant Name: Expanded form of the facility name if Project number is facility name. Otherwise, Plant Descriptions can be used.

It is vital that Piping, Equipment, Civil, Instrument, and Electrical disciplines designers liaise at project commencement to agree on global origin and coordinate system. If a plant coordinate system is specified by Saudi Aramco for the project, it shall be used.



5.2.3 Project Hierarchy Based on Design Areas

The Design Areas & Models under each Discipline shall be created as per the following guidelines:

Design Area: Design areas shall be created for each Plant discipline wise.

Design Area Name: The design area naming shall be done as per the following naming convention:

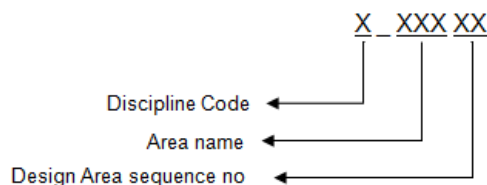
Discipline Code – 1 char as per below table

Code	Discipline
A	Architecture
C	Civil
E	Electrical Equipment
F	Fire Protection and Safety
G	General
I	Instrumentation
M	Mechanical Equipment
P	Piping
R	Raceway Cable Trays
S	Structural

Area name – 3 to 4 characters. (Consistency to be maintained in the number of characters)

Design Area sequence no – two digit integer like 01, 02.

As examples Piping Design Areas in Plant K45 will be P_K4501, P_K4502 etc. Similarly, Equipment Design Areas in Plant K45 will be M_K4501, M_K4502, etc.



Design Area Description: Suitable description to be given. The area descriptions given below for the design areas P_K4501 & P_K4502 can be taken as guidelines.

LAUNCHER & RECEIVER PIPING 15 M to 20M

LAUNCHER & RECEIVER PIPING 20M to 25M

Model: The models shall be created in respective disciplines under respective Design Areas. The model number & model descriptions shall be done in such a way that a user can locate a plant item from the correct model and the correct design area with ease.

Model Number: The Model number shall reflect the Discipline, Design Area & Sequence number. The model naming shall be done as per the following naming convention.

Design Area name – As specified above.

Model sequence no- a two digit integer as 01, 02.



For example: the piping models in P_K4501 design area shall be P_K450101, P_K450102, etc. Similarly first Equipment Model in Design Area M_K4502 shall be M_K450201. The second equipment model in the same Design Area shall be M_K450202.

Model Description: Two ways can be adopted to give the Model Description and the suitable one shall be used consistently. If it is not specific to certain volume within the design area, Description, Discipline & Model no. (E.g., WATER INJECTION PLANT PIPING MODEL #1) shall be used. If the model is specific to certain volume within the design area, the model name shall reflect the same, e.g., K44 FEED SURGE DRUM PIPING.

5.2.4 Systems Based Project Hierarchy

5.2.4.1 Alternatively, if the project is based on systems hierarchy, the systems shall be a concatenation of following with an underscore between the third and fourth items:

- Discipline Type Name
- Saudi Aramco Plant Name (X88)
- Saudi Aramco Unit Name (100)
- Two Digit Sequence Number or Logical Naming Convention per Contractor

Example when Plant and Unit are different:

System Type	Default Name
Piping System	PipngX88100_01
Equipment System	EqpX88100_01
Electrical System	ElecX88100_01
Conduit System	CndtX88100_01
Structure System	StrctX88100_01
Generic System	OfflinstrX88100_01

Example when Plant and Unit are same:

System Type	Default Name
Piping System	PipngX88_01
Equipment System	EqpX88_01
Electrical System	ElecX88_01
Conduit System	CndtX88_01
Structure System	StrctX88_01
Generic System	OfflinstrX88_01

5.2.4.2 All disciplines (Piping, Equipment, Electrical, Conduit, Instrumentation, and Structural) shall be created under the unit level only.

5.2.4.3 Pipeline Systems shall be created under the piping system of the applicable unit. The name of the Pipeline system shall consist of two parts separated by a single dash (e.g., CWS-0001):

- Fluid Code (e.g., CWS)
- Piping System Sequence Number (e.g., 0001)

- 5.2.4.4 Pipe runs shall be created under the appropriate Pipeline System and both shall have the same sequence number. The name of a pipe run shall be the tag number as specified in [Section 10](#) of this standard.
- 5.2.4.5 Contractor shall share with EK&RD the philosophy of starting and ending Pipe Runs prior to commencement of 3D Modeling.
- 5.2.4.6 Contractor shall share with EK&RD the philosophy of starting and ending Pipelines prior to commencement of 3D Modeling.
- 5.2.4.7 The Equipment Discipline shall have the following sub-systems (Mechanical, Vessel, Heat Transfer, and Miscellaneous).
- 5.2.4.8 The Electrical, Conduit, and the Structural sections do not require subdivisions; however, Contractor may subdivide them as per project requirements and best practices.
- 5.2.4.9 Contractor may further organize the subsystems of the disciplines other than Piping (Equipment, Electrical, Instrumentation, and Structural) into further logical subsystems according to the Contractor's best engineering practices. However, this organization structure must remain consistent for the entire project.



5.3 3D Database Template

- 5.3.1 If available, Contractor shall create the 3D design using the Saudi Aramco 3D Database Template. It is contractor's responsibility to ensure that all information in the template complies with the latest applicable Saudi Aramco standards.
- 5.3.2 The 3D Database Template consists of a Catalog, Naming Rules, and Drawing Borders. The Catalog is a comprehensive computer specification that lists the Piping Material Classes of the SAES-L-105 (Saudi Aramco Piping Specification). The Naming Rules applies Saudi Aramco Standard naming convention to Pipe Runs, Mechanical Equipment, Electrical Equipment, Instruments, Cables and Conduits, and Drawings.
- 5.3.3 To maintain uniqueness of Line Class names in the template, suffix “_1” shall be added to Line Classes of Part-I of SAES-L-105 in case of duplication with Part-II, i.e., (1CA1P_1 for Part I, and 1CA1P for Part II).



5.3.4 Contractor shall add any customizations that do not exist in the template but are required for the project after obtaining approval from EK&RD. Examples of these customizations include but are not limited to:

- Adding or modifying Piping Line Classes
- Adding or modifying components
- Creating or modifying Drawing Borders

5.3.5 Contractor shall populate all title block attributes in the applicable properties as set in the template. It is the Contractor's responsibility to ensure that any of these automatically populated values are correct.

5.3.6 Contractor shall configure the requested numbers for tags and drawings prior to loading the Template. It is the Contractor's responsibility to ensure that the automatically generated Tag and Drawing Numbers are correct and comply with the naming convention of this standard.

5.3.7 For calculated wall thicknesses, the Design Engineering team is required to submit a Safety Instruction Sheet per the appropriate Saudi Aramco Standards and submit it for verification as part of the design package.

5.3.8 Contractor acknowledges that the Template is provided as a design reference tool only and is not a substitute for Engineering Design. For example the template automatically selects materials for a given pipe and assigns wall thicknesses based on inputted temperature and pressure. These are provided as a reference only and it is the Contractor responsibility to make them appropriate for the project design.

5.3.9 Contractor shall ensure that all automatically calculated properties, placed components and derived attributes are appropriate for the project design and comply with all applicable Saudi Aramco standards. A procedure for modifying automatically placed wall thickness is available upon request.

5.3.10 Contractor shall record all modifications to the Template by logging them in the issue log form.

5.3.11 Contractor shall highlight any add, modify, delete changes.

5.3.12 Contractor shall submit the modified Catalog in its final form as part of the deliverables.

6. NAMING CONVENTIONS

The following naming conventions for the plant items shall be followed wherever applicable.

6.1 Pipe Run (Line Number) Label

Refer to [Section 10](#) of this standard for the Saudi Aramco pipe tag naming convention. An Example is provided below for your reference:

Example: 2-1/2"-CWS-1234-1CS1P1

The default definition shall be followed for the line id (Fluid Code + Line Sequence Number).

6.2 Equipment Tag Naming Convention

Populate the Equipment Number in the following format, ensuring that the Equipment Tag matches the Data-Centric P&ID Equipment Tag.

Refer to [Section 10](#) of this standard for the Saudi Aramco equipment tag naming convention. An Example is provided below for your reference:

Example: K45-GM-0001

6.3 Instrument Tag Naming Convention

Populate the Instrument Tag Number in the following format, ensuring that the tag number matches the Data-Centric P&ID and Data-Centric Instrumentation databases.

Refer to [Section 10](#) of this standard for the Saudi Aramco instrument tag naming convention. An Example is provided below for your reference:

Example: H46-21-FIT-0001



7. MODELING

7.1 Equipment Modeling

The main purpose of equipment modeling is to provide 3D shapes with intelligent tags, for extracting plot plans, space reservation for clash detection, provide nozzle orientation drawings and reports, inter-discipline reference and to be indicative of the actual shape for design review purposes.

Equipment items shall be built using the parametric equipment available wherever possible, e.g., for horizontal and vertical vessels, pumps, air coolers, and exchangers. Primitive shapes shall only be used if no parametric equipment is available.

All items modeled must have a datum point.



The following items are required to be modeled using the approved 3D design software:

- 7.1.1 All Equipment (new, future and existing) as applicable and above grade portion of foundations shall be modeled.
- 7.1.2 Packages such as Air compressors and Lube oil consoles shall be modeled with sufficient detail.
- 7.1.3 Platforms (Slabs) and ladders attached to equipment and supplied by vendor (such as for dressed vessels or fin fan motor access)
- 7.1.4 All nozzles.
- 7.1.5 Equipment withdrawals drop out zones, manway and hatch access shall be modeled with the correct aspects and shall be associated to the equipment.
- 7.1.6 Buildings (use block shapes) including all entrances and exits.
- 7.1.7 Safety, maintenance and access ways (including corrosion probe withdrawal areas), main escape routes and vehicle access shall be modeled with the correct aspects and shall be associated to the equipment.
- 7.1.8 Miscellaneous steel and platforms.
- 7.1.9 Major electrical equipment, control panels and junction boxes (by Electrical).
- 7.1.10 Foundations supporting horizontal vessels and exchangers from grade.
- 7.1.11 Skid mounted equipment shall be modeled in the same level of detail as non-skid mounted equipment and in sufficient detail to enable access and maintenance clearances, interface connections, lifting and handling requirement.
- 7.1.12 Level instruments.
- 7.1.13 Bases for models, vehicles, personnel and operators.
- 7.1.14 Minimum properties to be keyed in for Equipment are Equipment Tag Number, Equipment Name, and insulation thickness. All these values shall match the P&ID.

7.1.15 The minimum required nozzle attributes shall be Tag Number, Size, Pressure Rating, Piping Material Class and End Preparation.

7.1.16 All Tagged Items shall be modeled and match with the corresponding Tag in the P&ID.



7.2 Piping Modeling

Piping design shall take responsibility for plot space management, but all disciplines are equally responsible in a clash free design. Civil, Instrument and Electrical shall reference Equipment and piping models at all times.

No hand annotation of isometric dimension or Bill of material is acceptable.

7.2.1 All above ground piping larger than ½” & all underground piping shall be modeled. This includes all in-line items, instrumentation such as pressure points and thermowells, vessel trim piping including level Instruments, pipe supports, and firefighting systems.

7.2.2 The slope of pipelines, flare lines, sewer lines, airlines, and other lines which are sloped shall be modeled.

7.2.3 All pipe fittings shall be modeled.

7.2.4 All valves used in P&IDs shall be modeled. The model shall incorporate, but not limited to, the following:

- Instrument Root valves
- Chain operators
- Valve extension stems
- Motor Operators
- Gear operators
- Control valve operators

7.2.5 All branch connections for in-line instruments shown on the P&ID shall be modeled.

7.2.6 Level instruments forming part of vessel trim shall be modeled and shall be shown on the isometric drawings. In order to overcome disjointed isometrics resulting from trim line numbers, each separate portion of the line shall be given a suffix after the

-
- main line number, i.e., line number 100 shall have suffix 100A, 100B, etc.
- 7.2.7 Pipe supports for lines larger than 2" shall be shown in the 3D model.
- 7.2.8 Pipe Run/Piping Segment Data shall be in sync with P&IDs.
- 7.2.9 Pipe Run/Active Segment shall have all the applicable data properly filled. Normal Operating Pressure & Temperature, Normal Design Pressure & Temperature shall be available for each pipe run/segment.
- 7.2.10 Unit Code shall have the Plant Numbers such as K81, K82, etc. Unit Number shall bear the Unit numbers such as 21, 22, etc., if applicable. It is mandatory to correlate the lines with the P&IDs, where Plant/Area/Unit (PAU) hierarchy shall be followed.
- 7.2.11 Tags and associated data shall be entered in consistent manner as defined by this appendix.
- 7.2.12 Pipe/Line material class shall comply with SAES-L-105.
- 7.2.13 Pipe class service/fluid codes shall comply with SAES-L-105.
- 7.2.14 Piping Spec Customization shall follow SAES-L-105. Required customization shall be done to have the correct tables in the relevant Library. Ensure that each 'PMC' refers to the correct Diameter Table, Fluid Code, Service Limit Table, Branch Tables, Thickness Tables, etc., and each of these have the entries as per SAES-L-105 only.
- 7.2.15 Piping designers must continually monitor the P&IDs and Steelwork for changes and take corrective actions to ensure consistency.
- 7.2.16 If specification (spec) change occurs, it is often better to remodel than attempt to revise existing segment and pipe.
- 7.2.17 Due to potential of creating overlapping segments, the use of automatic placement, except for very simple, isolated, configurations is discouraged.
- 7.2.18 Piping shall carry all attributes required in accordance with the piping line lists and additional attributes associated with construction, commissioning, inspection and testing.
-

7.2.19 Insulation shall be dimensionally correct around all components.

7.2.20 Process, Utility and drain piping of all sizes as shown on the P&ID shall be modeled.



7.3 Structural Modeling

This section describes the general model requirements and the procedure for correct modeling.

7.3.1 All structural steel and concrete structures shall be modeled including columns, beams, platforms, floors, ladders and stairs, bracing, pipe racks and pipe supports. All structural objects must have proper relationships with each other.

7.3.2 Large connection plates, base plate stiffeners and bracing gusset plates shall be included in the model.

7.3.3 Miscellaneous materials such as small gusset plates, stiffener plates, angle plates, etc., can be exempted from modeling.

7.3.4 The model must be at the correct plant co-ordinates.

7.3.5 The model shall be dimensionally 100% accurate.

7.3.6 The physical members of the model must exactly correspond to the intended individual members of the erected structure.

7.3.7 When horizontal bracing passes below platform beams neither the beams nor the braces shall be split.

7.3.8 Column splices must be in the correct location, separating individual physical members.

7.3.9 Member orientations must be correct especially vertical braces.

7.3.10 Fireproofing type, thickness, etc., shall be applied to all structural members that are fireproofed.

7.3.11 Anchor bolt chairs and anchor bolt projection above the base plate shall be modeled if there is any potential for interference with equipment, piping, electrical items.

7.3.12 Members must be modeled to the proper work points' Horizontal bracing and members used for lateral restraint must be at the correct T.O.S. elevation. Vertical bracing must be modeled to the actual work points.



- 7.3.13 The model must match all relevant drawings. When modifications are necessary, the model must be changed, the frozen views updated, and the drawings revised.
- 7.3.14 Beam lengths shall account for framing clearances. e.g., when beams are connected at the outside of a cantilever portion of a structure, the beam that is being framed into shall be modeled to the outer flange of the connecting beam.
- 7.3.15 The structural model shall be based on the American Institute of Steel Construction (AISC) Section Table.
- 7.3.16 All members must be placed with the correct orientation. Braces must be placed with correct work points and orientation, such that the model matches the planned structure, as it will be erected. When braces cross members to which they are not connected, the braces must be placed such that they are continuous and not overlapping.
- 7.3.17 Braces shall be moved to the correct work points.
- 7.3.18 Offsets are used for moving the member cross-section relative to the member line. This is required when the section is offset to a point that is not represented with a cardinal point. Offsets are used to offset members (horizontally and vertically) from their placement point, whilst retaining their integrity with the member they were placed on, for example:
- a) Horizontal Braces

The brace member line is placed at the same elevation as the other members at that level, and then the brace is lowered to avoid overlapping.
 - b) Girts

Girt member lines are in the same plane as the column centroid. The cross-section is rotated and the cardinal point is set such that the cross-section extends from the centerline of the column outwards.
 - c) Members that are placed above or below other members, but are in contact with these members.
- Note.** *The place beam and place horizontal brace commands include a field (delta TOS) for vertically offsetting the member from the given elevation. Alternatively, 'the*

modify offset' command from the manipulate tool palette may be used.

- 7.3.19 Double angle channels shall be modeled as individual physical members and include the separation distance between the angles to accommodate the connection plate thicknesses.
- 7.3.20 All models shall have a propagated (frozen) data to enable access by other disciplines. This is a solid model showing the true representation of all structural elements and therefore the preferred data for reference. Generation of subsequent update of the frozen model is the responsibility of the structural modeler.
- 7.3.22 Finalize the paving and grading plan, obtain the (Finished Grade Level (FGL) elevations, and reflect that in the model. If you are working in existing facility, verify that the model matches existing FGL.



7.4 Electrical Raceway Modeling

All above ground cable trays 150 mm wide and over shall be modeled, including risers from underground ducts. In congested areas or where a number of trays less than 150 mm wide run side by side, smaller trays may be placed for space reservation purposes. Cable trays and ladder racks less than 150 mm wide shall also be shown where routed to motors and control stations.

Electrical Junction boxes (with a length greater than 250 mm in any direction), Light Fittings and Control Stations shall be modeled for space reservation by placing a Manual Fitting.



7.5 Volumes and Groupings

- 7.5.1 Contractor shall create the necessary Drawing Volumes. The hierarchy and naming of the Drawing Volumes shall match the hierarchy of the applicable Drawings.
- 7.5.2 Contractor shall, at least, create groupings (or ability to search/filter) the 3D components in the 3D model by Saudi Aramco Plant. This shall enable the generation of a 3D model review for each plant separately.



8. DRAWINGS AND REPORTS

- 8.1 The drawing types that can be generated from the approved software include, but not limited, the types mentioned in the below table.

Any drawing type required by the plant operation from the below table shall be generated by Contractor using the approved software.

INDEX	DRAWING TYPE	DESCRIPTION
A	EQA	EQUIPMENT ARRANGEMENT/LAYOUT/ LOCATION/LEGEND
	FPP	FACILITY PLOT PLAN
L	ISO	ISOMETRIC PIPING DETAIL/ISOM
	PDT	PIPING SECTION/DETAIL/ELEVATION
	PPL	PIPING PLAN/LAYOUT/ARRANGEMENT
	PPL	PIPELINE ROUTING (ABOVE /UNDER GROUND/SUB MARINE)
M	SDT	OFFSHORE PLATFORM PLAN/SECTION/ELEVATION/DETAIL
	SDT	PIPE RACK DETAIL
	SDT	PIPEWAY SLEEPER PLAN/SECTION/ELEVATION
	SDT	ROOF FRAMING PLAN/SECTION/ELEVATION
	SDT	STRUCTURAL ELEVATION/LAYOUT/PLAN
	SDT	STRUCTURAL PLATFORMS
	SDT	WALKWAY PLAN/SECTION/ ELEVATION
J	RAK	INSTRUMENT RACK LAYOUT
	RAK	RACK LAYOUT
P	CBL	CABLE TRAY/RACEWAY PLAN/LAYOUT
	CBL	CONDUIT LAYOUT
	CBL	CONDUIT RACEWAY PLAN/LAYOUT
	CBL	CONDUIT & JUNCTION BOX ARRANGEMENT



- 8.2 When modifications are necessary, Contractor shall update the 3D model and regenerate any affected drawings. Drawings shall always reflect the current status of the 3D model. The final 3D model and drawings shall be revised to reflect the As-built status of the plant.
- 8.3 Drawings Hierarchy Structure shall match the hierarchy in the 3D model, which is comprised of Saudi Aramco Facility, Plants, and Units.
- 8.4 Contractor shall generate drawings under the applicable parent directories to which they belong (i.e., the Piping Plan of a unit shall be placed under the parent unit and the Facility Plot Plan of a plant shall be placed under the parent plant).
- 8.5 A folder containing Facility Plot Plans (FPP) of Saudi Aramco Plants shall be created under the respective Saudi Aramco Plant level. All other drawing types (ie ISO, EQA, PPL, etc.) shall be placed under their respective folder created under the Unit level. The drawing folder name shall be the drawing type as per the table in 8.1 of this appendix above.



8.6 Drawing Names shall follow the Saudi Aramco Drawing Number format.

8.7 Drawings and Reports submitted to Saudi Aramco shall have customized Title Block as per [Section 6](#) of this standard.

8.8 Contractor shall add the Facility Key Plan to each drawing type except isometric and ensure that the arrow is pointing to the correct location.

8.9 Add the Key Map to each Drawing Border except isometric and ensure that the arrow is pointing to the correct location in the Key Map (Saudi Aramco Plant or Unit).

8.10 Isometric Drawings shall have the Saudi Aramco Drawing Number of the continuation isometric drawing, when applicable (i.e., CONT ON BA-123456001).

8.11 The minimum isometric drawings data requirements are:

- Standard Detail Reference Drawings
- Notes
- Spools to be fabricated by Vendor
- Spools to be fabricated by Saudi Aramco
- Reference Drawings
- Issued for Construction Stamp
- Revision Validation
- Bill of Materials
- Shop Materials
- Pipe Support Details
- Other than Shopping Materials

13.2 Required Data at the bottom of isometric drawing:

- General Notes
- Piping Material Class
- Design Temperature
- Design Pressure
- Operating Temperature
- Operating Pressure
- Test Pressure
- Test Medium
- Radiography %
 - Shop
 - Field
- Insulation
 - Thickness

- Type
- Stress Analysis Required Y/N
 - If Yes provide Drawing Number ie Safety Instruction Sheet
- Line ID



9. DATA CHECKS & CLEANUP

9.1 General

- All temporary areas, models, files and directories, systems, drawings, volumes and WBS items shall be removed prior to delivery.
- All Equipment and Electrical Raceway models shall be loaded to Database.
- All hierarchies must be clean and accurate. There should be no design objects at the root level, including but not limited to, Equipment, Pipelines, Member systems, etc.
- The 3D Database shall be clean of errors and has no pending actions.
- The complete model shall be free of clashes. Interference checking shall be run periodically to ensure clash free environment. The model shall be capable of executing interference checks and generating reports of “hard” and “soft” clashes, for resolution. “Hard” clashes refer to actual physical interference of equipment, while “soft” clashes refer to interference with space required for maintenance and operation purposes. Equipment and other components and the space allocated shall be modeled to the extent necessary, and to ensure the validity of the clash check. Construction tolerances shall be included in interference checks.

9.2 Piping

- Piping isometrics must be generated successfully for all pipelines. Lines that fail to extract correctly need to be modified prior to delivery.
- Piping Design Database shall be without errors for all Piping Models.
- The model shall be up-to-date with the reference data. All applicable verification reports shall be run and sent to Saudi Aramco as part of the submittal.

9.3 Structural

- The Structural Model shall be without errors.
- Temporary views and objects shall be removed.
- Propagated model shall be updated.

10. PROJECT DELIVERABLES



Contractor shall ensure that all the models & the data in the backup are in As-built state. The final 3D model submittal shall be one combined (merged/consolidated) for the entire project/facility, regardless whether one or multiple contractors are working on the project. The deliverables submitted shall contain, but not limited to, the following:

- 10.1 Complete backup of the plant 3D model and all its associated drawings and data using the approved version of the 3D design and database software.
- 10.2 Complete file structure of the Project including all models, reference data, drawings, the project seed, configuration, Drawing Border files, etc.
- 10.3 Review models/files for the whole project shall be generated and submitted to Saudi Aramco. Review models/files shall also be generated for each plant individually if the project covers multiple Saudi Aramco Plants. The review models/files shall reflect the latest and most updated models and it shall be generated prior to submittal.
- 10.4 Complete Project archival backup.
- 10.5 Complete Reference Data.
- 10.6 All the forms including customized forms and files used in the project.
- 10.7 All Piping Component Data and Piping Material Class data used in the project.
- 10.8 All Isometric seed used for extracting Piping Isometrics.

A text file containing clear instructions of the used seed files (border, definition file, etc.) for restoring and generating Isometrics.

- 10.9 All report formats used for report extraction.
- 10.10 Following Reports shall be generated before data handover and made available in the reports folder under the file structure:
 - Final interference Check Report.
 - Final verification report for all the models.
 - Reference data conflict report for all the models.
 - Equipment report.
 - Model list report.
 - Line list report.

- Material Take-Off Report
- Hierarchy Report

10.11 Piping Isometric drawings, piping plan & other orthographic drawings as per Section 8 of this appendix. Drawings submitted to iPlant and the drawings generated from 3D modeling system shall be the same in the native format of the generation tool.

10.12 Submittal form shall be delivered with every submittal. It shall contain complete information about the delivery and list of all generated drawings.

10.13 All customized and external reference files and programs required to utilize the full functionality of the submitted 3D model.

Appendix F – Data-Centric Instrumentation Specification

1. INTRODUCTION

This appendix defines the requirements for preparing the Data-Centric Instrumentation Drawings and other related documents for Saudi Aramco using the Data-Centric Instrumentation design software approved by Saudi Aramco. It is Contractor responsibility to request the approved Data-Centric Instrumentation design software name and version, database name and version, and the Instrumentation Template from EK&RD.

2. CONFLICTS AND DEVIATIONS

Any conflicts between this appendix and other applicable Saudi Aramco Engineering Standards (SAESs), Procedures (SAEPs), Materials System Specifications (SAMSSs) and Standard Drawings (SASDs) shall be resolved in writing with EK&RD.

3. REFERENCES

Refer to applicable Saudi Aramco Engineering Standards (SAESs), Procedures (SAEPs), Materials System Specifications (SAMSSs) and Standard Drawings (SASDs).

4. SCOPE (General)

- 4.1 Contractor shall follow this appendix as the basis for building the Data-Centric Instrumentation drawings to be submitted to EK&RD.
- 4.2 All documents associated with instrumentation data shall be generated automatically from the Data-Centric Instrumentation software without any post-modification as per Section 16 of this appendix. The generated documents shall comply with (SAESs and SAEPs).
- 4.3 This appendix defines the set-up, design and instrument tag naming conventions, and required data.
- 4.4 Contractor shall obtain the approved Data-Centric Instrumentation Template from EK&RD in order to develop SAES-compliant instrumentation drawings. Any additional customizations required by the project shall be carried out by the contractor after obtaining EK&RD approval.
- 4.5 The drawings and documents generated shall be submitted to Saudi Aramco in compliance with this standard and SAEP-334.

- 4.6 The final Data-Centric Instrumentation database delivered to EK&RD shall have the entire drawings and data in 'As-built' stage.
- 4.7 Contractor shall upgrade the Data-Centric Instrumentation database to the latest approved version at the time of final data delivery.
- 4.8 The final Data-Centric Instrumentation delivery shall be one combined (merged/consolidated) database for the entire project/facility, regardless whether one or multiple contractors are working on the project.

5. DATA-CENTRIC INSTRUMENTATION SET-UP

5.1 General

- 5.1.1 Contractor shall use the latest approved version of the Data-Centric Instrumentation Template for setting up the instrumentation design database.
- 5.1.2 Contractor shall perform the initial setup in-line with EK&RD design convention as per this appendix.

5.2 Data-Centric Instrumentation Project Initialization

Contractor shall request EK&RD for the parameters that he shall use for initializing the Data-Centric Instrumentation for the project.

5.3 Plant Hierarchy Structure (PAU)

The project plant structure shall be defined as “Plant – Area – Unit”. The values of facility name, plant number, plant description, unit number and unit name shall be used as defined in iPlant.

Data Hierarchy Format:

PAU	Required	Values
Plant	Yes	Facility Name/Description
Area	Yes	Plant Number/Description
Unit	Yes	Unit Number/Description

5.4 Naming Conventions

The naming format of Instrument, Loops, Cables Equipment's and Lines tags shall comply with [Section 10](#) of this standard. The template database is pre-configured with these naming conventions.

Drawing Numbers naming format shall comply with [Section 6](#) of the standard.

5.5 Units of Measure (UOM)

Unit of measures (UOM) shall comply with SAES-J-003 and SAEP-301.

6. INSTRUMENT INDEX DATA

The instrument index shall be developed in conjunction with the P&IDs. The index serves as the indices to each individual instrument (hard or soft tag) and supporting documents and drawings.

The tags to be added to the database include:

- All visible instrument tags on the P&ID, including soft tags
- Implied instrument tags on the P&ID, based on project requirements
- Vendor tags, based on project requirements
- Control Systems tags

Tags and associated data are to be entered in full and consistent manner. This shall aid in future sort and reports developed as the project progresses. All entries into the index shall be in upper case.

Tags shall be delivered with the following associations: Loop data, manufacturer data, P&ID references, line number details, process data, calibration data and required fields as specified in this appendix. All face data appears on Saudi Aramco Instrument Installation Schedule (IIS) shall be filled in.

Legend:

Min – This data must be filled when entering any new tag as a minimum.

IIS – This data appear on the Installation Schedules

No	Required Data	Remarks	Min	IIS
1	Tag Number		✓	✓
2	Tag Class		✓	
3	Instrument Type		✓	✓
4	Tag Service Description		✓	✓
5	Loop Number		✓	
6	Loop Measured Variable		✓	
7	Loop Type		✓	
8	Loop Function		✓	
9	Loop P&ID		✓	
10	Loop Note			
11	Internal Loop Order		✓	
12	Status		✓	

No	Required Data	Remarks	Min	IIS
13	Supply Responsibility			
14	Operating Area		✓	
15	Risk Area		✓	
16	Parallel Area			
17	Location		✓	
18	I/O Type		✓	
19	Signal Type		✓	
20	System Type		✓	
21	I/O Location		✓	
22	Device Protocol		✓	✓
23	Equipment		✓	
24	Line		✓	
25	P&ID		✓	✓
26	Manufacturer		✓	✓
27	Model		✓	
28	Power Supply			
29	Package Vendor			
30	Aramco MR Number		✓	✓
31	MR Number			
32	MR Item Number		✓	✓
33	ISS Drawing Number		✓	✓
34	ILD/ISD Number		✓	✓
35	Mounting Type		✓	✓
36	Instrument Mounting Drawing No.	(Instrument Points & Lines Layout)	✓	✓
37	Instrument Piping Detail Drawing No.	(Piping Isometric)	✓	✓
38	Remark - IIS			✓
39	Remark - Design			
40	Remark - Engineering			
41	Remark - Vendor			
42	Remark - PCS Group			
43	Remark - Domain Admin			
44	Remark - PCS Vendor			
45	VOD Tag No.	Applicable to MOV/AOV/HOV/GOV IIS drawings		✓
46	Insp. Mark No.	Applicable to Relief Valves IIS dwg		✓
47	Control System Tag		✓	
48	Service Descriptor 1		✓	
49	Service Descriptor 2		✓	
50	Min DCS Range	Lower Range Limit		
51	Max DCS Range	Upper Range Limit		
52	DCS Range UOM	Engineering Unit		
53	Alarm High			
54	Alarm High High			
55	Alarm Low			
56	Alarm Low Low			
57	High Trip			

No	Required Data	Remarks	Min	IIS
58	High High Trip			
59	Low Trip			
60	Low Low Trip			
61	Alarm Priority			
62	Sequence Of Events (SOE)			
63	I/O Address			
64	Valve Action on Power Failure			
65	Control Action			
66	Valve Critical Level			
67	Contact Open			
68	Contact Close			
69	State 0 Descriptor			
70	State 1 Descriptor			
71	State 2 Descriptor			
72	Redundancy			
73	Simple PID Controller			
74	Switch Label			
75	Scan Type			
76	Input Type			
77	Pulse Rate			
78	Totaliser Timebase			
79	Modbus Address			
80	Modbus Station			
81	Modbus Alias			
82	Modbus Signal Data Type			
83	FF Segment	FF Segment Name		
84	FF Device Tag			
85	FF Device Address			
86	FF Device Type			
87	Deviation Alarm			
88	Deviation Comparison			
89	F&G Zone			
90	Lower Transducer Range Limit			
91	Upper Transducer Range Limit			
92	Transducer Engineering Units			
93	Substation			
94	Logic System No			
95	Bench Condition			
96	MOS Required	Maintenance Override Switch		
97	MOS Group Number			
98	MOS Alarm			
99	Damper Required			
100	ATFO Required	Automatic Transfer Fault Override Criteria		
101	Signal Repeater Required			
102	Surge Arrestor Required			
103	Low Scale (mA)			
104	High Scale (mA)			

No	Required Data	Remarks	Min	IIS
105	Under Range 1	Transmitter Under Range Position 1		
106	Under Range 2	Transmitter Under Range Position 2		
107	Over Range 1	Transmitter Over Range Position 1		
108	Over Range 2	Transmitter Over Range Position 2		
109	LAS Function	Device Class Basic or Link Master		
110	ITK Revision	Device Revision		
111	DD Revision	DD File Revision		
112	CFF Revision	Capability File Revision		
113	PFD Drawing Number	Applicable to (Relief Valve) IIS drawings.		✓
114	Valve Type	Applicable to MOV/AOV/HOV/GOV IIS drawings		✓
115	Valve Size	Applicable to MOV/AOV/HOV/GOV IIS drawings		✓
116	Rating	Applicable to MOV/AOV/HOV/GOV IIS drawings		✓
117	INLET Size	Applicable to Relief Valves IIS drawings		✓
118	INLET Rating	Applicable to Relief Valves IIS drawings		✓
119	INLET Facing	Applicable to Relief Valves IIS drawings		✓
120	OUTLET Size	Applicable to Relief Valves IIS drawings		✓
121	OUTLET Rating	Applicable to Relief Valves IIS drawings		✓
122	OUTLET Facing	Applicable to Relief Valves IIS drawings		✓
123	Orifice Area	Applicable to Relief Valves IIS drawings		✓
124	Set Pressure	Applicable to Relief Valves IIS drawings		✓

6.1 Tag Number

This field provides the alphanumeric identification of all instruments, including soft tags.

6.2 Tag Class

Tag Class	Description
Conventional	A tag number that does not belong to the Fieldbus, telecom, electrical, or typical class.
Foundation Fieldbus	An instrument associated with a Foundation Field segment.
Profibus-DP	An instrument associated with a Profibus DP (Decentralized Periphery) segment.
Profibus-DA	An instrument associated with a Profibus PA (Process Automation) segment.
HART	A 'Highway Addressable Remote Transducer' instrument.

6.3 Instrument Type

Denotes the instrument type. Examples: PRESSURE TRANSMITTER, PRESSURE GAUGE, etc. These descriptions shall be defined in instrument type supporting table as per SAES-J-003 and duplicate instrument types shall be avoided. .

6.4 Tag Service Description

This field is used to define the overall use or service for an instrument. It is normally referenced on data sheets, nameplates, loop drawing titles, and the IIS. It shall be concise and precisely describes the process service of the instrument.

6.5 Loop Number

This field indicates the tag's associated loop identification number. It is important to get this association correct to facilitate correct loop generation.

All tag numbers in the index shall have a Loop Number except for the gauges, test wells and relive valves.

The following table lists the minimum required data against a Loop Number that has to be populated:

Field	Required	Remarks
Loop Number	✓	
Loop Measure Variable	✓	i.e., FLOW (F), LEVEL (L), etc.
Loop Type	✓	Typical Loop Number Ref
Loop Function	✓	i.e., CONTROL INDICATING, RECORDING, etc.
Loop P&ID	✓	

Field	Required	Remarks
Loop Note	✓	

6.6 Internal Loop Order

The order of the tags within the loop is normally in the order in which they have been entered into the loop number. Usually, they are sorted by physical order from primary to final element.

This determines the order in which they appear on the ILD's and how the IIS is sorted.

6.7 Status

This field is used to determine whether an instrument is new, old, to be relocated, existing, deleted, etc. This data is used to identify the status of the instrument and to help filter the data. The status value is selected from the Status Support Table. A null entry is default in this field and it is intended on the Project that this represents a new instrument.

Status	Description
blank	Current Tag (Default)
DEL	Deleted Tag Number
EIP	Existing Device to be reused in place
ER	Existing Device to be relocated and reused
FN	Furnished by others
OLD	Old device not to be revamped
REL	Relocated Device

6.8 Supply Responsibility

Used to define the instrument supply responsibility such as:

Name	Description
blank	Supplied by Contractor (Default)
-	Not Applicable (i.e., Software Tags)
BY VENDOR	Supplied by Vendor
BY ELECTRICAL	Supplied by Electrical
BY PIPING	Supplied by Piping

* Supply Responsibility Table to be updated as needed.

6.9 Operating Area

The following Acronyms are examples of Operating Areas: OA-1, OA-2, OA-3, OA-4, OA-5 and for Plant Interface Buildings: PIB-01, PIB-02, PIB-03, PIB-04, PIB-05, CCR, ECC (Emergency Control Center), etc.

** Operating Area to be updated as needed.*

6.10 Risk Area

** Risk Area to be updated as needed.*

6.11 Parallel Area

Parallel equipment number can be indicated in case of parallel process area or instrumentation, i.e., K00-G-001A and K00-G-001B.

6.12 Location

This denotes the device's physical location. For interconnecting signals between two systems it must represent the second connected system to the tag.

The following Acronyms can be used.

Acronym	Description
-	Software Tag
BMS	Burner Management System
CCR	Central Control Room
CCS	Compressor Control System
CRMS	Corrosion Monitoring System
DCS	Distributed Control System
ESD	Emergency Shutdown System
FAS	Fire Alarm System
FIELD	Field Instrument
HVAC	Heating, Ventilation and Air Conditioning
LP	Local Panel
MCC	Motor Control Center
MPP	Motor Protection Panel
PLC	Vendor PLC
PMS	Power Management System
SDS	Smoke Detection System
TCS	Turbine Control System
VMS	Vibration Monitoring System

Acronym	Description
WS	Weather Station

* Location Table to be updated as needed.

6.13 I/O Type

This field represents the I/O type of the Instrument. The I/O is associated to the system within the 'System Type' field.

I/O Type	I/O Type Description
-	No I/O
AI	Analog Input
AIS	Analog Input Soft
AO	Analog Output
AOS	Analog Output Soft
DI	Digital Input
DIS	Digital Input Soft
DO	Digital Output
DOS	Digital Output Soft
DN	Device Net
FF	Foundation Fieldbus
PI	Pulse Input
RTD	Resistance Temperature Device
SDI	Digital Input with Line Monitoring
SDO	Digital Output with Line Monitoring
SIA	Serial Interface - Analogue
SID	Serial Interface - Digital
SW	Software
TC	Thermocouple

* I/O Type Table to be updated as needed.

6.14 Signal Type

Signal Type associated with the IO Type can be:

Signal Type	Description
4-20mA	4-20mA
4-20mA EXT	4-20mA Externally Powered
1-5V	

120Vac	
120VDC	
24VDC	24 Volts DC
48VDC	48 Volts DC
FREE	Free Voltage
TYPE K	
PT100	
JPT100	
PULSE -2V/-18V	
PULSE 3V/12V	
RTD	

* Signal Type Table to be updated as needed.

6.15 System Type

System type code for what system the tag is linked with:

System	Description
-	No System
BMS	Burner Management System
ACS	Advanced Control System
CCS	Compressor Control System
DAHS	Data Acquisition and Historisation System
DCS	Distributed Control System
ESD	Emergency Shutdown System
LCP	Local Control Panel
FAS	Fire Alarm System
MCC	Communication module of MCC for Winding Temperature
MDVMS	Multi Drop Vibration Monitoring System
OTS	Operator Training Simulator
PGCDS	Process Gas Chromatograph Data System
PLC	Programmable Logic Controller
VMS	Vibration Monitoring System

* System Type Table to be updated as needed.

6.16 I/O Location

This field is required to enable the PCS vendor to determine which I/O points are associated with each building. For Example:

Building	Description
-	No I/O Location
AB-000	Analyzer Building
CCR	Central Control Room
ECC	Emergency Control Center
LB-000	Laboratory Building
MS-000	Maintenance Shop
PIB-00	Process Interface Building
SS-000	Substation

* I/O Location Table to be updated as needed.

6.17 Device Protocol

Protocol	Description
C	Conventional (e.g., 4-20mA)
F	Foundation Fieldbus
H	HART
M	Modbus
P	Proprietary Protocol (e.g., Profibus, etc.)

6.18 Equipment

This identifies the major piece of equipment that the tag is associated to. The Equipment Number and Equipment Description shall be updated for each piece of equipment.

Data	Required	Remarks
Equipment Number	✓	
Equipment Description	✓	
Equipment Type	✓	

6.19 Line

This field denotes the Line Number on which the instrument is associated with. This number will generally match with line numbers from the LDT and is selected from the Line Number support table.

In the Line Number Support Table the following fields are required to be filled in:

Data	Required	Remarks
Line Number	✓	
P&ID	✓	
Stream		
Pipe Spec	✓	
Pipe Standard	✓	
Pipe Material	✓	
Size	✓	
Unit	✓	
Schedule/PN	✓	
Internal Diameter		
Wall thickness		

6.20 P&ID

This field indicates the P&ID drawing number reference for each instrument. The P&ID is selected from the P&ID Drawing support table. This field shall have the complete drawing number along with the sheet number.

6.21 Manufacturer

This field represents the Manufacturer of the instrument. This field is selected from the Manufacturer support table and is normally specified during the preparation of the instrument data sheets. Manufacturers shall comply with SAES-J-003.

The following information has to be populated in the Manufacturer support table:

Data	Required	Remarks
Instrument Manufacturer	✓	
Description	✓	
Manufacturer Identification	✓	Vendor/Plant ID (refer to SAES-J-003)

6.22 Model

This field represents the Model Number of the instrument. This field is selected from the Model support table and is normally selected during the preparation of the instrument data sheets.

The following information has to be populated in the Model support table:

Data	Required	Remarks
Instrument Model	✓	
Description	✓	
Model Identification	✓	
Process Function	✓	

6.23 Power Supply

If a power supply is required then the following information must be filled:

Data	Required	Remarks
Rated Voltage	✓	
Type	✓	
Frequency	✓	
Number of Phases	✓	

6.24 Package Vendor

Name of the instrument package, vendor is supplying.

6.25 Aramco MR Number

Saudi Aramco MR Number.

6.26 MR Number

This field denotes the instrument Material Requisition Number. This field can be auto-populated from procurement system used by the contractor.

6.27 MR Item Number

This field denotes the MR Item Number assignment. After an instrument has been assigned to an MR and given an item number assignment in procurement system.

6.28 ISS Drawing Number

This field indicates the Instrument Specification Sheet Number and it is assigned when preparing an instrument data sheet. While this field is listed as part of the instrument index, it is actually assigned and edited from the Specification Sheet module, not the Index module.

This field shall have the complete drawing number along with the sheet number.

6.29 ILD/ISD Number

This field indicates the Loop Drawing Number for an instrument assigned to a loop that requires a loop drawing. While this field is listed as part of the instrument index, it is actually assigned from the Loop module when assigning a loop drawing to a loop. Any tag assigned to the loop inherits the loop drawing number assignment.

This field shall have the complete drawing number along with the sheet number.

6.30 Mounting Type

Mounting types appears on IIS:

Mounting	Description
F	Field Mounted
P	Panel Mounted
H	Horizontal Mounted
V	Vertical Mounted

F/P is applicable for Flow/Level/Pressure/Temperature field instruments.

H/V is applicable for all Valves that are not in F/L/P/T loop.

6.31 Instrument Mounting Drawing No.

Instrument Points and Lines Layout Drawing Number.

6.32 Instrument Piping Detail Drawing No.

Piping Detail Drawing Number.

6.33 Remark - IIS

This field appears on the Instrument Installation Schedules.

6.34 Remark – Design

This field is used by Design to make any remarks regarding an instrument.

6.35 Remark – Engineering

This field is used by engineering to make any remarks regarding an instrument.

6.36 Remark – Vendor

This field is used by any 3rd party Vendors to make any remarks regarding an instrument.

6.37 Remark – PCS Group

This field is used by the PCS group to make any remarks regarding an instrument.

6.38 Remark – Domain Administrator

Control System Remarks by Domain Administrator.

6.39 Remark – PCS Vendor

Control System Remarks by PCS Vendor.

6.40 VOD Tag Number

This field indicates the Valve Operating Diagram Tag Number which appears on the IIS for the miscellaneous valves.

6.41 Insp. Mark No.

This field indicates the Inspection Mark No which appears on the IIS for Relief Valves.

6.42 Control System Tag

Shall be generated as defined in the naming convention. Contractor shall be responsible of the accuracy and matching between the CS tags and the PCS tags.

6.43 Service Descriptor 1

Based on the Tag Service.

6.44 Service Descriptor 2

Based on the Tag Service.

6.45 Min DCS Range

Lower Range Limit.

6.46 Max DCS Range

Upper Range Limit

6.47 DCS Range UOM

Range Unit of Measure.

6.48 Alarm High

Alarm High Set point. For non-Process instruments.

6.49 Alarm High High

Alarm High High Set point. For non Process instruments.

6.50 Alarm Low

Alarm Low Set point. For non Process instruments.

6.51 Alarm Low Low

Alarm Low Low Set point. For non Process instruments.

6.52 High Trip

Trip Set point. Applicable to Software Alarm coming from Logic.

6.53 High High Trip

Trip Set point. Applicable to Software Alarm coming from Logic.

6.54 Low Trip

Trip Set point. Applicable to Software Alarm coming from Logic.

6.55 Low Low Trip

Trip Set point. Applicable to Software Alarm coming from Logic.

6.56 Alarm Priority

Alarm priority can be:

Alarm Priority	Description
LOW	For High/Low Alarms
HIGH	For High High/Low Low
HIGH HIGH	For High High/Low Low Trip Alarm

* Alarm Priority to be updated as needed.

6.57 Sequence of Events

SOE	Description
Blank	No Sequence of Events
Y	Sequence of Events

6.58 I/O Address

Sequential No. for each I/O Type module to identify the I/O segregation

6.59 Valve Action on Power Failure

Controller Output	Description
DIR	Direct
REV	Reverse

* Some companies refer to this as 'Output Action'

6.60 Control Action

Control Action can be:

Control Action	Description
D	Direct (Analogue)
R	Reverse (Analogue – Default)
0	Direct (Digital – Default)
1	Reverse (Digital)
2	Inverted connect direct action (Digital)
3	Inverted connect reverse action (Digital)

6.61 Valve Critical Level

Critical Valve	Description
Yes	Critical Valve
No	Not a Critical Valve

6.62 Contact Open

Di/Do signal status when contact open/de-energized.

6.63 Contact Close

Di/Do signal status when contact closed/energized.

6.64 State 0 Descriptor

This field is applicable only for some software signals.

6.65 State 1 Descriptor

This field is applicable only for some software signals.

6.66 State 2 Descriptor

This field is applicable only for some software signals.

6.67 Redundancy

Module Redundancy	Description
Y	Redundant
N	Not Redundant

6.68 Simple PID Controller

This field may be used to specify if the controller in the field or in the Host.

FF_PID	Description
Y	PID in Field Device (e.g., simple control, one transmitter and one valve)
N	PID in Host (e.g., more than one valve for split range, cascade, compensation control, etc.

6.69 Switch Label

Instrument Label Number for switch or digital I/O.

Label	Description
ON	Off, On
RUN	Stop, Run
OPEN	Close, Open
HIGH	Middle, Low, High
RIGHT	Middle, Left, Right
DIRECT	Stop, Revers, Direct
START	Hold, Stop, Start
STOP	Pause, Start, Stop
UP	Down, Up
START	Pause, Restart, Start2

6.70 Scan Type

Scan Type	Description
0	Std/Basic (Default)
1	Medium/High
2	High (CS3000 only)

6.71 Input Type

Input Type	Description
LINEAR	Default
SQRT	Square Root
2ST	2 position status
3ST	3 position status
BTHPUL	Pulse Train
CODE	Code conversion
SUBSYS	Subsystem communication
PULSE	Control priority type pulse train
QTPUL	Exact totalisation pulse train

Input Type for FF-AI block	Description
1	Direct (Default)
2	Indirect
3	Ind Sqr Root

6.72 Pulse Rate

6.73 Totaliser Timebase

Totaliser Timebase	Description
SS	Sec totalise
SM	Min totalise
SH	Hour totalise
SD	Day totalise
PR	PRn (n=Pulse Rate)

6.74 Modbus Address

Subsystem Modbus Address/OPC item name.

6.75 Modbus Station

Subsystem Modbus Station No/OPC IP addresses.

6.76 Modbus Alias

Modbus Alias Number.

6.77 Modbus Signal Data Type

Comm. Signal Data Type.

Data Type	Description
16/32	Modbus – 16/32 bits signed/unsigned integer
32/64	Modibus – 32/64 bits floating
DI/DO	Modibus – Discrete Input / Output
VT_UI2/4/8	OPC
VT-R4/R8	OPC
VT-I2/4	OPC
VT-BOOL	OPC

6.78 FF Segment

Foundation Fieldbus Segment Name.

6.79 FF Device Tag

Foundation Fieldbus Device Tag Number.

6.80 FF Device Address

Foundation Fieldbus Node Address.

6.81 FF Device Type

Foundation Fieldbus Device Type Number.

6.82 Deviation Alarm

DCS Deviation Alarm (By Process).

6.83 Deviation Comparison

DCS Deviation Comparison.

6.84 F&G Zone

Zone Level of the Fire & Gas Protection.

6.85 Lower Transducer Range Limit

Normally 5% of the DCS Range.

6.86 Upper Transducer Range Limit

Normally 5% of the DCS Range

6.87 Transducer Engineering Units

Same Engineering Units as the DCS Range.

6.88 Substation

Substation Number.

6.89 Logic System No.

ESD Interlock System for Loop Diagrams.

6.90 Bench Condition

For digital signal only.

Bench Condition	Description
OPEN	
CLOSE	
TRIPPED	
NORMAL	

6.91 MOS Required

Maintenance Override Switch.

MOS Required	Description
Blank	Does Not Require MOS
Y	Requires MOS

This can be used by CS vendor to generate the serial tag according to the MOS. Example:

- MOS activated from DCS to ESD can end with a “BP” suffix.
- MOS activated from ESD to DCS can end with a “BY” suffix.
- MOS alarm on DCS can end with a “BA” suffix.

6.92 MOS Group Number

Maintenance Override Switch Group Number.

6.93 MOS Alarm

Maintenance Override Switch Alarm.

6.94 Damper Required**6.95 ATFO Required**

Automatic Transfer Fault Override Criteria.

Air Connection	Description
Y	Yes
Blank	No

6.96 Signal Repeater Required**6.97 Surge Arrestor Required****6.98 Low Scale (mA)****6.99 High Scale (mA)****6.100 Under Range 1**

Transmitter Under Range Position 1.

6.101 Under Range 2

Transmitter Under Range Position 2.

6.102 Over Range 1

Transmitter Over Range Position 1.

6.103 Over Range 2

Transmitter Over Range Position 2.

6.104 LAS Function

Device Class Basic or Link Master.

6.105 ITK Revision

Device Revision.

6.106 DD Revision

DD File Revision**6.107 CFF Revision**

Capability File Revision

6.108 PFD Drawing Number

The Process Flow Diagram that the valve appears on. Applicable to (Relief Valves) IIS drawings.

6.109 Valve Type

Applicable to (MOV/AOV/HOV/GOV) IIS drawings.

6.110 Valve Size

Applicable to (MOV/AOV/HOV/GOV) IIS drawings.

6.111 Rating

Applicable to (MOV/AOV/HOV/GOV) IIS drawings.

6.112 INLET Size

Applicable to (Relief Valves) IIS drawings.

6.113 INLET Rating

Applicable to (Relief Valves) IIS drawings.

6.114 INLET Facing

Applicable to (Relief Valves) IIS drawings.

6.115 OUTLET Size

Applicable to (Relief Valves) IIS drawings.

6.116 OUTLET Rating

Applicable to (Relief Valves) IIS drawings.

6.117 OUTLET Facing

Applicable to (Relief Valves) IIS drawings.

6.118 Orifice Area

Applicable to (Relief Valves) IIS drawings.

6.119 **Set Pressure**

Applicable to (Relief Valves) IIS drawings.

7. **INSTRUMENT SPECIFICATION DATA**

7.1 Instrument Specification sheets (ISS) format shall comply with Saudi Aramco Engineering Standards and procedures.

7.2 Standard ISS forms shall be used according to the list in SAES-J-003. The required forms are available in Data-Centric Instrumentation Database template. There shall be no modifications to the standard forms unless it is approved in writing by the Supervisor, EK&RD/Drawing Management Unit. Any SAES-J-003 forms that are not available in the template database shall be developed by the contractor and submitted to EK&RD for approval prior to use.

If no form is available for a special instrument application, a new form can be developed by the contractor after P&CSD approval. The new form is to follow the same pattern as the standard instrument specification sheets and the form shall be submitted to EK&RD for approval.

7.3 All required Saudi Aramco Title Block data shall be entered in accordance with [Section 6](#) of this standard.

7.4 A single tag specification sheets shall be used.

8. **PROCESS DATA**

All process data fields that appear on the ISS for each instrument and line shall be filled in.

9. **INSTRUMENT INSTALLATION SCHEDULE (IIS) DATA**

All Instrument Installation Schedule data fields that appear on Saudi Aramco's IIS drawing for each instrument shall be filled in. Field of all IIS fields are marked with “✓” in Section 6 of this appendix.

10. **CALCULATIONS DATA**

All required calculation attributes along with other process data shall be filled for all instrument tags.

Preliminary in-house sizing calculations for flow meters, control valves, thermowells and relief valves can be used. However, the final calculations shall be performed using the vendor sizing programs or project-approved methods.

11. WIRING DATA

11.1 General

- 11.1.1 Instrument device panels, system panels and junction boxes with terminal details shall be created within the Domain area. Standard junction boxes and instrument devices shall be set up in the Reference area initially.
- 11.1.2 Standard single pair/triad and multi-pair/multi-triad cables shall be created from the details in the Instrument Wire and Cable Specification.
- 11.1.3 All connection types shall be created to ensure the correct termination of all types of cables to the various panel types.
- 11.1.4 All Instrument Type Profiles shall be defined.

11.2 Panels

- 11.2.1 All standard panels including their strips, terminals, I/O terminations, and I/O cards shall be created to serve as the plant panel typical configurations to facilitate rapid creation of various panels in the domain.
- 11.2.2 All plant panels including their strips, terminals, I/O terminations, and I/O cards shall be created.
- 11.2.3 All panels and their strips and terminals details shall be filled in with the following details:

Panel Type	Data	Required	Remarks
Conventional Device Panels	Name	✓	
	Type	✓	
	Area Classification	✓	
	Strip Name	✓	
	Strip Type		
	Strip Sequence	✓	
	Terminal Number	✓	
	Terminal Sequence	✓	
Multi-Input Device	Name	✓	

Panel Type	Data	Required	Remarks
Panels	Type	✓	
	Strip Name	✓	
	Strip Type		
	Strip Sequence	✓	
	Terminal Number	✓	
	Terminal Sequence	✓	
	Apparatus	✓	
	No. of Left side connections	✓	
	No. of Right side connections	✓	
	Port Name	✓	
	Port Function	✓	
	Male/Female	✓	
	Connectors	✓	
FF Device Panels	Name	✓	
	Type	✓	
	Strip Name	✓	
	Strip Type		
	Strip Sequence	✓	
	Terminal Number	✓	
	Terminal Sequence	✓	
	Port/Spur Name	✓	
	Male/Female	✓	
	Connectors	✓	
General Panels: Junction Boxes, Marshalling Cab., Local Panels, etc.	Name	✓	
	Type	✓	
	Manufacturer	✓	
	Model	✓	
	Location	✓	
	Drawing Number (Area Classification)	✓	
	Strip configuration name	✓	
	Strip total number of terminal	✓	
	Strip First terminal number	✓	
	Terminal numbering details.	✓	
	Strip Rail	✓	
	Strip Type	✓	Ex. 24 VDC, 4-20 ma, RTD ...etc.
	Strip Manufacturer	✓	
	Strip Model	✓	

Panel Type	Data	Required	Remarks
FF Junction Boxes	Name	✓	
	Type	✓	
	Manufacturer	✓	
	Model	✓	
	Location	✓	
	Drawing Number (Area Classification)	✓	
	Segment in	✓	
	Segment out	✓	
	No of left spur connectors	✓	
	No of right spur connectors	✓	
	Internal Terminator	✓	
	Segments Name	✓	
	Spur Name	✓	
	Port Name	✓	
	Connector Type	✓	
	Male/Female	✓	
Control System Cabinet	Name	✓	
	Network/Address1	✓	
	Node/Address2	✓	
	Type	✓	
	Manufacturer	✓	
	Model	✓	
	Location	✓	
	Drawing Number (Area Classification)	✓	
	Rack name	✓	
	Number of Slots	✓	
	Rack Sequence	✓	
	Strip Name	✓	
	Terminal Number	✓	
	Number of terminals per channel	✓	
	First channel	✓	
	Strip Rail	✓	
	Strip Type	✓	
	Strip Manufacturer	✓	
	Strip Model	✓	
	Panel Name	✓	
	Rack Name	✓	

Panel Type	Data	Required	Remarks
	Slot Number	✓	
	I/O Card Name	✓	
	I/O Card Type	✓	
	I/O Card Manufacturer	✓	
	I/O Card Model	✓	
	I/O Card System I/O Type	✓	
	I/O Card Module	✓	
	I/O Card Controller/Processor	✓	
	Redundant Cabinet	✓	If Applicable
	Redundant Rack	✓	If Applicable
	Redundant Slot	✓	If Applicable
	Redundant I/O Card	✓	If Applicable
	Channel	✓	
	FF Segment Channel	✓	

11.2.4 Panels, strips, and terminal numbering will be as per the project Instrumentation Numbering Philosophy.

11.3 Cables

11.3.1 Standard cables, sets and wires shall be created from the details of the Instrument Cable Specifications and the Electrical Cable Specifications, which will serve as the plant cable typical configurations to facilitate rapid creation of various cables in the domain.

11.3.2 Create all cables, sets and wires.

11.3.3 All cables and wire details shall be filled in with the following details:

Data	Required	CCS	Remarks
Cable Name	✓	✓	
Cable Description	✓	✓	CCS: Service name
Cable Type	✓		
Manufacturer	✓		
Model Name	✓		
Model Description	✓	✓	CCS: Conductors No. & Size
Model Insulation	✓	✓	CCS: Conductors Type + "-" + Volts
Color	✓		
Length	✓	✓	
UOM	✓	✓	
Cable Harness	✓		
End 1 Location	✓		
End 2 Location	✓		
Glands End 1	✓	✓	
Glands End 2	✓	✓	
Connector for End1	✓		
Connector for End2	✓		
Cable Load HP/KVA	✓	✓	To be used for CCS drawings
Cable Load Volts	✓	✓	To be used for CCS drawings
Conductor Type	✓	✓	To be used for CCS drawings
Cable Remarks	✓	✓	To be used for CCS drawings

11.4 Cable Routing Data

11.4.1 Cable routings for cable conduits and trays shall be created as per the project specifications. Cable routing sections shall be associated with all applicable CCS drawings can be generated.

11.4.2 All cable routings details shall be filled in with the following details:

Data	Required		Remarks
	Min.	CCS	
Routing Standards Width	✓	✓	
Routing Standards Position	✓		
Max. cables per Position	✓		
Routing Section Name	✓		

Data	Required		Remarks
	Min.	CCS	
Routing Section Description*	✓	✓	CCS: Conduits Type + "-" + Bends
Routing Section Length	✓	✓	
Routing Section Category	✓	✓	

* Routing section Description can be edited through SA_Conduit_Info.

12. PCS DATA

The data transfer between the Data-Centric Instrumentation system and the PCS Vendor is the responsibility of the contractor.

The following PCS data shall be entered into the Data-Centric Instrumentation System:

- Hardwired I/O information for DCS system, including Foundation Fieldbus signals.
- Hardwired I/O information for ESD/VMS/CCS systems, including HART signals.
- Hardwired I/O information for MDF cabinets.
- System Cables information.
- MDF signal termination details.
- All cross wiring.
- Control System tags.

13. CALIBRATION DATA

Calibration data for all instruments that requires calibration shall be entered into the system with full detail.

Ranges and Output Signals

Data	Required	Remarks
Variable min	✓	
Variable min UOM	✓	
Variable max	✓	
Variable max UOM	✓	
Output Signal min	✓	
Output Signal max	✓	
Output Signal UOM	✓	

Data	Required	Remarks
Output Type	✓	

Errors/Points

Data	Required	Remarks
Error Calculation Type	✓	
Number of points	✓	
Measuring points	✓	
Error Type	✓	
Set Values	✓	
Tolerance Data	✓	

Display Scales

Data	Required	Remarks
Minimum	✓	
Maximum	✓	
UOM	✓	

Alarm/Trips

Data	Required	Remarks
Point Type	✓	
Description	✓	
Point Level	✓	
Direction	✓	
Point Value	✓	
UOM	✓	
Min low	✓	
Max High	✓	

14. SUPPORTING DATA

Supporting data shall be updated with all required information as per the project specification, including:

1. Instrument Types;
2. System I/O Types;
3. Foundation Fieldbus Function Blocks;
4. Locations;

5. Manufacturers;
6. Instrument Models; and
7. Loop Types and Functions.

15. DATA-CENTRIC INSTRUMENTATION DELIVERABLES

The following instrumentation drawings shall be generated from the Data-Centric Instrumentation system as per SAES-J-003:

- Instrument Installation Schedules (IIS)
- Instrument Specification Sheets (ISS) with Instrument Calculation Sheets
- Instrument Loop Diagrams (ILD)
- Instrument Segment Diagrams (ISD)
- Instrument Interconnection Wiring Diagrams (ECD) – Junction Box Terminations & Marshalling Cabinet Terminations
- Cable & Conduit Schedule (CCS).

The file naming of these drawings shall comply with [Section 5](#) of this standard.

The Data-Centric Instrumentation system shall contain all required data to generate the above drawings. Post modifications to these drawings are not allowed. These drawings shall be delivered to EK&RD in PDF format.

15.1 Instrument Installation Schedule (IIS)

Instrument Installation Schedule (IIS) format shall comply with Saudi Aramco Engineering Standards. These drawings shall be prepared in the Data-Centric Instrumentation system based on the EK&RD provided drawing templates.

15.2 Instrument Specification Sheets (ISS)

Instrument Specification sheets (ISS) format shall comply with Saudi Aramco Engineering Standards. ISS shall be prepared as per Section 7 of this appendix.

15.3 Instrument Loop Diagrams (ILD)

Instrument Loop Diagram shall be generated using the Data-Centric Instrumentation system. The generated ILD shall comply with this standard and SAES-J-003. Post-modification of the generated drawings after customization shall be stored in the Data-Centric Instrumentation system.

All used templates, symbols, borders paths shall be in the “C:\SAUDIARAMCO\INSTRUMENTATION\ILD\” folder.

The path for the Field Instruments symbols in ILD shall be in the following folder:

“C:\SAUDIARAMCO\INSTRUMENTATION\INSTRUMENTSYM\”

15.4 Instrument Segment Diagrams (ISD)

Instrument Segment Diagrams shall comply with this standard, SAES-J-904, and SAES-J-003. Post-modification of the generated drawing after customization shall be stored in the Data-Centric Instrumentation system.

All used templates, symbols, borders paths shall be in the “C:\SAUDIARAMCO\INSTRUMENTATION\ISD\” folder.

15.5 Instrument Interconnection Wiring Diagrams (ECD)

The Junction Box and Marshalling Racks/cabinets Interconnection diagrams shall comply with this standard and SAES-J-003. Post-modification of the generated drawing after customization shall be stored in the Data-Centric Instrumentation system.

All used templates, symbols, borders paths shall be in the “C:\SAUDIARAMCO\INSTRUMENTATION\ECD\” folder.

15.6 Cable & Conduit Schedule (CCS)

Cable & Conduit Schedule (CCS) format shall comply with Saudi Aramco Engineering Standards.

CCS shall be delivered to Saudi Aramco in PDF format according to the following:

CCS Fields		Remarks
	CABLE/CONDUIT NUMBER	
	SERVICE	
LOAD	HP OR KVA	
	VOLTS	
GLAND TYPE	FROM END	End_1
	TO END	End_2
RUN	FROM END	Connection to End_1
	TO	Connection to End_2
CONDUITS	TYPE	desc to be used for Conduits Type and Bends with a "-" separation. A browser need to be created for this.
	SIZE	
	LENGTH Ft/m	
	BENDS	
CONDUCTORS	TYPE	
	NO. & SIZE	
	INSULATION TYPE	insulation to be used for the Type and Volts with a "-" separation.
	INSULATION	

CCS Fields		Remarks
	VOLTS	
	TOTAL QTY Ft/M	
	REMARKS	

16. DATA HANDOVER

The Data-Centric Instrumentation database shall be handed over to Saudi Aramco at different project review milestones (30%, 60%, 90%, IFC and Final As-built).

- 16.1 All temporary instruments, panels, loops, cables, layouts, equipment's, lines, test data, views and drawings not requested from iPlant shall be removed from the database before delivery.
- 16.2 Ensure all data is free of any database exceptions and orphan entries.
- 16.3 The database shall reflect the As-built stage of the plant.
- 16.4 All temporary project and subproject data shall be cleared prior to data handover.
- 16.5 The following data shall be handed over to Saudi Aramco at each delivery:
 - 16.5.1 The Data-Centric Instrumentation database in the approved Saudi Aramco format.
 - 16.5.2 Custom views, scripts and user preferences settings utilized by Contractor to generate drawings.
 - 16.5.3 All symbols, custom symbols, border templates, ISS illustrated images and reports used to generate the required drawings.
 - 16.5.4 Compliance document highlighting all approved deviations from this Appendix;
 - 16.5.5 All generated drawings with documentation showing the list of all drawings and procedure used to generate them from the provided items above.
 - 16.5.6 Submittal form shall be delivered with every submittal containing complete information about the delivery and list of all generated drawings.

Attachment 5 – Loop Typicals

The following list shows sample Loop Typicals.

** To be updated as required by the project.*

LOOP TYPICAL	INTERNAL LOOP ORDER	INSTRUMENT TYPE	INSTRUMENT TYPE DESCRIPTION
F-001	1	FE	ORIFICE PLATE
	2	FIT	FLOW INDICATING TRANSMITTER
	3	FI	DCS FLOW INDICATOR
F-006	1	FE	ORIFICE PLATE
	2	FIT	FLOW INDICATING TRANSMITTER
	3	FC	DCS FLOW CONTROLLER
	4	FXV	SOLENOID VALVE
	5	FLSC	LIMIT SWITCH CLOSED
	6	FLSO	LIMIT SWITCH OPEN
	7	FCV	FLOW CONTROL VALVE
	8	FLLC	DCS VALVE CLOSED INDICATION
	9	FLLO	DCS VALVE OPEN INDICATION
	10	FALL	DCS FLOW ALARM LOW LOW
	11	FAL	DCS FLOW ALARM LOW
	12	FAH	DCS FLOW ALARM HIGH
	13	FAHH	DCS FLOW ALARM HIGH HIGH
H-002	1	HCV	HAND CONTROL VALVE
	2	HLSC	LIMIT SWITCH CLOSED
	3	HLSO	LIMIT SWITCH OPEN
	4	HC	DCS HAND CONTROLLER
	5	HLLC	DCS VALVE CLOSED INDICATION
	6	HLLO	DCS VALVE OPEN INDICATION
L-007	1	LIT	LEVEL INDICATING TRANSMITTER
	2	LC	DCS LEVEL CONTROLLER
	3	LXV	SOLENOID VALVE
	4	LLSC	LIMIT SWITCH CLOSED
	5	LLSO	LIMIT SWITCH OPEN
	6	LCV	LEVEL CONTROL VALVE
	7	LLLC	DCS VALVE CLOSED INDICATION
	8	LLLO	DCS VALVE OPEN INDICATION
	9	LALL	DCS LEVEL ALARM LOW LOW
	10	LAL	DCS LEVEL ALARM LOW
	11	LAH	DCS LEVEL ALARM HIGH
	12	LAHH	DCS LEVEL ALARM HIGH HIGH

Appendix G – Data-Centric Electrical Specification

1. INTRODUCTION

This document defines the requirements for preparing the Data-Centric Electrical Drawings and Reports for Saudi Aramco using the Data-Centric Electrical Design Software approved by Saudi Aramco. It is Contractor responsibility to request the approved Data-Centric Electrical Design software name and version, database name and version, and approved Electrical Template from EK&RD.

2. CONFLICTS AND DEVIATIONS

Any conflicts between this appendix and other applicable Saudi Aramco Engineering Standards (SAESs), Procedures (SAEPs), Materials System Specifications (SAMSSs) and Standard Drawings (SASDs) shall be resolved in writing with EK&RD.

3. REFERENCES

Refer to applicable Saudi Aramco Engineering Standards (SAESs), Procedures (SAEPs), Materials System Specifications (SAMSSs) and Standard Drawings (SASDs).

4. SCOPE

- 4.1 Contractor shall follow this appendix as the basis for the creation and delivery of the Data-Centric Electrical drawings.
- 4.2 This appendix defines the set-up, guidelines for drafting and the minimum data to be populated in the Data-Centric Electrical database and list of deliverables. The Data-Centric Electrical drawings for the project to Saudi Aramco EK&RD shall be delivered according to this appendix.
- 4.3 When requested, EK&RD will provide to the contractor, the Data-Centric Electrical Database template comprising of customized Data Dictionary and Reference files, which shall be used for the setup and drawings creation. However, contractor shall develop any additional forms, symbols, tools and/or templates as per the project requirements. Contractor shall obtain EK&RD approval prior to the creation of any form, symbol, border, and/or template.
- 4.4 The technical contents of the engineering drawings including engineering data properties, attachments and any other engineering information related to the electrical drawings shall be delivered per this specification.

- 4.5 Contractor shall create all required forms and drawings per this standard.
- 4.6 The Data-Centric Electrical system shall be used to generate Single Line Diagrams (E1L), Three Line diagram (E1L), Cable & Conduit Schedule (CCS) and Electrical Load Tabulation (SCH).

Note: *A one-line diagram or single-line diagram (SLD) shows by means of single lines and graphical symbols the course of an electrical circuit or system. Prior approval shall be obtained from EK&RD to waive creating Three-line diagram from the Data-Centric Electrical system.*

- 4.6 All Drawings and Reports submitted to Saudi Aramco shall have customized border and title block information as per this standard.
- 4.7 All drawings associated with electrical data shall be generated automatically from the Data-Centric Electrical system without any post-modification. The generated documents shall comply with all applicable SAESs, SAEPs, and SASDs. Relocating any item on the drawing in a single line diagram generated from the Data-Centric Electrical system is not considered post modification.
- 4.8 All inconsistencies must be resolved. Any inconsistency that can't be resolved shall be documented and submitted to EK&RD for approval.
- 4.9 All drawings and data shall reflect the plant As-built status before making the final delivery to Saudi Aramco.
- 4.10 Check List in Attachment 2 shall be used to ensure the quality, reliability and integrity of the electrical data.
- 4.11 The delivered database must be free of any database exceptions and orphan entries.
- 4.12 The delivered database shall be free from any test items, test data, test drawings, and temporary reports.
- 4.13 Contractor shall upgrade the database to conform to the latest approved version of the Data-Centric Electrical system prior to final delivery.

5. DATA-CENTRIC ELECTRICAL SET-UP

5.1 General

Contractor shall use the latest version of the Data-Centric Electrical system approved by Saudi Aramco.

5.2 Database Setup

The database shall be set up and configured as shown below:

Database Storage Name: TS_XXX_DATA_01*
 Temporary Database Storage Name: TEMP_XXX*
 Database User Name: XXXSITE*
 Database Password: XXXSITE123*

Where XXX = Plant\Org abbreviation from iPlant, "e.g., HGP for Hawiyah Gas Plant"

5.3 Plant Setup

The following plant's data shall be defined for each Facility. Ex.: Gas Plant, GOSP, etc.

Template Path: Template path
 Hierarchy: Plant/Area/Unit
 Plant Name: Facility Name
 Format File location: Reference Data path

Database Storage Name: TS_XXX_DATA_01*
 Temp Database Storage Name: TEMP_XXX*
 Database Username: XXXPLANT*
 Database Password: XXXPLANT123*

Where XXX = Plant\Org abbreviation from iPlant, "e.g., HGP for Hawiyah Gas Plant"

Following table lists the required data for each plant (Facility Name)

Description	Data entry	Example
Name	Yes	HGP
Description	Yes	Hawiyah Gas Plant
Location	Yes	HAWIYAH

5.4 Electrical Application Association

The following configuration shall be followed:

Electrical Reference Data path: Default Reference path
 Template Path: Template path
 Database Storage Name: TS_XXX_DATA_01
 Temporary Storage Name: TEMP_XXX
 Database Username: XXXPLANTE*
 Database Password: XXXPLANTE123*

Where XXX = Plant\Org abbreviation from iPlant, “e.g., HGP for Hawiyah Gas Plant”

5.5 Plant Hierarchy Structure

The project plant structure must comply with Hierarchy “Plant – Area – Unit”. All drawings shall be created at the Unit level only.

The following shall be applied to all project data:

- A Plant shall be *Facility Name*
- B Area shall be the Saudi Aramco plant number.
- C Unit shall be the Saudi Aramco Unit

5.6 Options Setup

Plant group type shall be set to “Unit” and the item type uniqueness level shall be set to “Plant” for the equipment listed in Saudi Aramco Standard Drawing AE-036411-003.

5.7 Installation Options

Contractor shall request EK&RD for the required installation options for the approved Data-Centric Electrical system.

6. NAMING CONVENTION

The naming format of electrical equipment and cables shall comply with [Section 10](#) of this standard.

Drawing Numbers naming format shall comply with [Section 5](#) of the standard.

7. DATA-CENTRIC ELECTRICAL REFERENCE DATA

7.1 Data-Centric Electrical Reference Data

7.1.1 Saudi Aramco Reference Data contains:

- Symbols.
- Saudi Aramco template, “i.e., E1L and Motor Control Schematics Border Files”.
- Rules.
- Formats.
- References.

- 7.1.2 Saudi Aramco Electrical Reference Data shall be used for the creation of all electrical drawings. Any additional symbols, templates, formats, reports, rules, that do not exist in the Reference Data and are required by the project shall be created as per ANSI/ISA standard after obtaining EK&RD approval.
- 7.1.4 Arial Font shall be used for all textual elements of the drawing.
- 7.1.5 A prior approval from EK&RD is required for any modification to the provided Saudi Aramco Reference Data.
- 7.1.6 The latest Saudi Aramco border files shall be used for the Data-Centric electrical drawings.
- 7.1.7 The minimum attributes that shall be filled for the specified equipment are as shown below:

Equipment Type	Minimum Attributes
Transformer	<ul style="list-style-type: none"> Type Connection type of transformers Rated Power Rated Voltage Number of phases Supply Frequency Phase arrangement Secondary output <ul style="list-style-type: none"> Rated power Nominal current Rated voltage current ratios for potential transformers
Motor	<ul style="list-style-type: none"> Rated Power impedance Rated Voltage Brake power Minimum Required power Number of phases Phase arrangement Full Load current
Capacitors Bank	<ul style="list-style-type: none"> Rated Power Rated Voltage Demand factor Supply Number of phases Frequency Number of wires

Equipment Type	Minimum Attributes
	<ul style="list-style-type: none"> Phase arrangement Operation Mode
Offsite Power Supplies	<ul style="list-style-type: none"> Rated voltage Offsite Power rated power Number of phase Offsite power load Full load current
Battery Charger	<ul style="list-style-type: none"> Rated Power Rated Voltage Number of phases Supply Frequency Phase arrangement Full load current Secondary output <ul style="list-style-type: none"> Rated Voltage Nominal current Rated Voltage
Battery Bank	<ul style="list-style-type: none"> Rated Active power Rated voltage Full load current Flooded seal Number of cells Float voltage
Generators	<ul style="list-style-type: none"> Rated Apparent Power Power Factor Rated Active power Supply Number of phases Frequency Rated voltage Efficiency Neutral earthing Number of poles Full load current Control mode
Power Distribution Boards (PDB's)	<ul style="list-style-type: none"> Current rating Frequency Number of phases Phase arrangement Rated voltage Short circuit current peak Short circuit current rating

Equipment Type	Minimum Attributes
	<ul style="list-style-type: none"> Short circuit duration short circuit rating
Automatic transfer switches	<ul style="list-style-type: none"> Current rating Frequency Number of phases Phase arrangement Rated voltage Short circuit current peak Short circuit current rating Short circuit duration short circuit rating
Protective Devices: Fuse and circuit breaker	<ul style="list-style-type: none"> Current rating Control voltage Rated Voltage Short Circuit rating Fuse size Circuit breaker trip class Full load current
Current Limiting Reactor	<ul style="list-style-type: none"> Rated Power Rated Voltage Frequency number of phases Full load current Insulation level Resistance Reactance Short circuit current (RMS) Short circuit Current [Peak] Power factor Basic impulse level
Control Panel:	<ul style="list-style-type: none"> Tag number
Junction Box	<ul style="list-style-type: none"> Tag number
Relay	<ul style="list-style-type: none"> Relay function
Uninterruptible Power Supply	<ul style="list-style-type: none"> Rated Power Rated Voltage Number of phase Frequency Phase arrangement Full load current Resistive losses Reactive losses Secondary output

Equipment Type	Minimum Attributes
	<ul style="list-style-type: none"> Rated power Nominal current Rated voltage
Electrical Bus	<ul style="list-style-type: none"> Bus current Voltage rating Rated power Phase Frequency

Note:

Contactor shall consult with EK&RD to obtain the latest additional attributes.

7.2 Saudi Aramco Electrical Dictionary

7.2.1 The Data Dictionary Contains:

- Data Attributes
- Select Lists

Note:

System Select Lists shall not be altered.

7.2.2 Saudi Aramco Electrical Data Dictionary shall be used for the creation of the electrical deliverables.

7.2.3 Any additional attribute, select list and their entries that do not exist in the Data Dictionary and are required by the project shall be created after obtaining EK&RD approval.

8. Data-Centric ELECTRICAL DELIVERABLES

8.1 Data Clean-up

8.1.1 All temporary drawings, test drawings, test symbols, test assemblies, test units, temporary filters and test reports shall be removed from the Data-Centric Electrical database before final delivery.

8.1.2 All inconsistencies on the Electrical drawings and reports must be resolved before the final delivery. A list of all inconsistencies that cannot be resolved shall be submitted along with Saudi Aramco approvals.

8.1.3 The Data-Centric Electrical database must be free of any database exceptions and orphan entries.

8.1.4 All the Electrical drawings and reports must be As-built before the final delivery.

8.1.5 Contractor must upgrade the Data-Centric Electrical database to the latest approved version prior to final delivery.

8.2 Deliverables

8.2.1 A complete Data-Centric Electrical database and project backup, including the Electrical Reference Data (symbols, templates, assemblies, report templates, rules, and modified programs) used to generate the electrical deliverables.

8.2.2 Compliance document highlighting all approved deviations from this specification.

8.2.3 Document specifying customizations carried out in reference data, symbols, data dictionary, formats, rules, and reports along with their approvals.

8.2.4 Any modified source code for all programs that were created for the Data-Centric Electrical system and must highlight the modifications versus delivered code.

8.2.5 PDF files of the following electrical deliverables as generated from the Data-Centric Electrical system:

- One Line Diagrams
- Cable and Conduit Schedules
- Electrical Load Tabulation

Attachment 6 – Border Title Block

Title Block Field Name	Display Name
PLANT NO	Plant No
INDEX	Drawing Index
DRAWING NUMBER	Drawing Number
SHT. NO.	Sheet No
REV.NO.	Revision
Location	Location
Drawing Title – Line 1	Title Line One
Drawing Title – Line 2	Title Line Two
Drawing Title – Line 3	Title Line Three
DRAWING TYPE	Drawing Type
JOB ORDER/EWO NO.	Job Order / EWO Number
Revision DATE	Revision Date
REVISION DESCRIPTION	Revision Description
Design Certification: ENGG.	Engineering By
Design Certification: DATE	Engineering Date
Design Certification: CERTIFIED BY	Certified By
Design Certification: CERTIFIED DATE	Certified Date
Review: CONST. AGENCY	Construction Agency
Review: CONST. DATE	Construction Agency Date
Review: OPERATIONS	Operations
Review: OPERATIONS DATE	Operations Date
Other: BY	Other
Other: DATE	Other Date
DCC Number	DCC No
EMERGENCY DRAWING	Emergency Drawing
Drawing Sensitivity	
Reference Drawing 1_Desc	Reference Drawing Desc 1
Reference Drawing 1_No	Reference Drawing No 1
Reference Drawing 2_Desc	Reference Drawing Desc 2
Reference Drawing 2_No	Reference Drawing No 2
Reference Drawing 3_Desc	Reference Drawing Desc 3
Reference Drawing 3_No	Reference Drawing No 3
Reference Drawing 4_Desc	Reference Drawing Desc 4
Reference Drawing 4_No	Reference Drawing No 4
Reference Drawing 5_Desc	Reference Drawing Desc 5
Reference Drawing 5_No	Reference Drawing No 5
NOTES	Description

Attachment 7 - Check Lists

1. GENERAL CHECK LIST

- 1.1 All Equipment listed in Saudi Aramco Standard Drawing AE-036411 sheet 003, cables and raceways shall be tagged.
- 1.2 The Special character apostrophe ' shall not be used to comment values of any attributes with unit of measure, in other words, unit attribute values shall not be commented.
- 1.3 All applicable data-attributes shall be filled to the fullest extent for all components such as equipment, cables, etc., in accordance with SAES.
- 1.4 Tags and associated data shall be entered in consistent manner as defined by this specification.
- 1.5 Saudi Aramco abbreviation conventions shall be followed as per SAES.
- 1.6 Drawing title block entries shall follow [Section 6](#) of this standard and the corresponding user-defined attributes shall be as defined in this appendix.
- 1.7 Use of Item Note and Labels to place dumb text is to be minimized. Intelligent labels shall be the default option.
- 1.8 Electrical Equipment Class and Electrical Equipment Sub-class shall be defined for all the customized symbols.
- 1.9 Detail sketches shall be placed as intelligent items or Auxiliary Graphics.
- 1.10 Nothing shall be placed outside the drawing border.
- 1.11 There shall be no linked files, other than the Saudi Aramco approved templates, to all drawings.
- 1.12 In case Contractor is forcing the re-creation of drawings from the data-centric database, all entities must be fetched from the database without any loss of information.

2. **EQUIPMENT CHECK LIST**

- 2.1 Electrical Equipment Class and Electrical Equipment Sub Class shall be the criteria for placing the equipment.
- 2.2 Equipment Tag Prefix, Tag Seq Number, and Tag Suffix are to be entered per this standard. Use of space or other characters to overcome the Duplicate Tag situation is not acceptable.
- 2.3 Equipment labels shall be standardized. If the Data-Centric Electrical system does not have the required properties, they shall be added with prior approval from EK&RD. If the labels do not have the proper units, the units shall be added with prior approval from EK&RD.

Appendix H – Building Information Modeling (BIM) Specification



1. INTRODUCTION

This document defines the requirements for preparing the Building Information Model (BIM) and its related engineering drawings for Saudi Aramco **whenever the use of BIM is mandated by the project.**

2. CONFLICTS AND DEVIATIONS

Any conflicts between this appendix and other applicable Saudi Aramco Engineering Standards (SAESs), Procedures (SAEPs), Materials System Specifications (SAMSSs) and Standard Drawings (SASDs) shall be resolved in writing with EK&RD.

It is the responsibility of CONTRACTOR to acquire the latest Saudi Aramco engineering documents (SAESs, SAEPs, SAMSSs, and SASDs) that are necessary to comply with the BIM requirements.

3. SCOPE

- 3.1 Contractor shall follow this appendix as the basis for BIM modeling and generating the applicable drawings, as listed in Section 7 of this appendix.
- 3.2 This appendix defines the project set up, guidelines for modeling, the minimum data to be populated in the database and the types of drawings to be generated.
- 3.3 Contractor shall carry out the necessary customizations required for modeling and subsequent drawing generation.
- 3.4 The technical contents of the engineering drawings including engineering data properties, attachments and any other engineering information for all disciplines shall follow applicable SAESs, SAEPs, SAMSSs, and SASDs.
- 3.5 All Drawings & Reports submitted to Saudi Aramco shall have the title block as per [Section 6](#) of this standard.
- 3.6 The drawings generated shall be submitted to Saudi Aramco as per this standard and SAEP-334.
- 3.7 The final Project backup delivered to Saudi Aramco shall have all the models and related drawings in 'As-built' state and shall have the minimum BIM Level of Development (LOD) of 500 and all model elements shall be field verified.



- 3.8 Contractor shall upgrade the project to the latest approved version of the software prior to final delivery.
- 3.9 Contractor shall prepare a **BIM Execution Plan (BEP)** for the complete project lifecycle and submit it to Saudi Aramco for approval.
- 3.10 **The BIM level of development matrix** shall be prepared by Contractor and approved by Saudi Aramco as part of the BEP at early stage of the project, which will be the basis of the design deliverables at all relevant stages.
- 3.11 Unless otherwise mandated by the owner scope requirements, contractor is highly recommended to provide level of development matrix to the level of LOD 500. **The project development matrix** shall be approved by Saudi Aramco as part of the BEP at early stage of the project, of which will be the base of the design deliverables at all relevant stages.
- 3.12 Contractor shall develop the BIM models for the project for the purpose of a **virtual walkthrough** ready to be shown using the Saudi Aramco's virtual reality equipment.
- 3.13 Contractor shall provide detailed project Level 3 schedule extracted from BIM with list of specific deliverables for production of design information for the entire project.
- 3.14 Contractor shall develop **the detailed list of Bill of Materials (BOM)** for the full project using the BIM model.
- 3.15 Contractor shall submit a full set of all required specifications without any deviation from Saudi Aramco Standards.
- 3.16 Contractor shall submit Tender Documents covering the requirements for constructing the facility. The documents shall include construction design changes compiled Drawings, Technical Specifications, reports, Bill of Quantity (BOQ) for master plan, civil engineering and architectural design requirements, structural and, Mechanical, Equipment, and Piping (MEP) engineering requirements and whatever applicable in Scope Of Work for each design and construction phases.
- 3.17 **Contractor shall produce all required shop drawings prior of construction directly from the BIM models.**
- 3.18 Contractor shall produce MEP/ HVAC, Shop – Fabrication and sleeve drawings, etc., after BIM coordination is completed for the area of construction requiring these drawings.
- 3.19 Contractor shall update Energy Optimization and Green Energy Report to include the effects of the manufacturing building design.



3.20 Contractor shall comply with GI-0710.002 and SAEP-334 for the level of the confidentiality and classification of the data, models, and drawings as restricted drawings, unless classified at higher level as confidential.

3.21 All models shall conform, by project phase, to the Level of Development (LOD) Matrix as listed in the below table “A” and confirmed at project kickoff and approved by Saudi Aramco:

Table A – LOD Requirements

Phase	LOD	Dimension
DBSP	200	<ul style="list-style-type: none"> • 3D • 4D • 5D (Budgetary Estimate)
Project Proposal (IFB)	300	<ul style="list-style-type: none"> • 3D • 4D • 5D (Bidding Stage)
Detail Design (IFC)	400	<ul style="list-style-type: none"> • 3D • 4D
Construction	400	<ul style="list-style-type: none"> • 3D • 4D • 5D (Change Orders)
As-built	500	<ul style="list-style-type: none"> • 3D (Operation and Maintenance)



3.22 BEP shall contain at least the minimum following information:

- Project Information
- BIM Scope
- Roles, Responsibilities, and Contact Information
- Project Templates And Standards
- Project Folders Structures & Data Security and Exchange Procedures.
- Modeling Strategy & Elements’ LOD
- Project Phases And Milestones
- Collaboration Plan
- Coordination Process And Design Change MoC Process
- 4D Sequencing
- 5D Cost Estimation
- Quality Control & Review Procedures
- BIM Design And Construction Deliverables

The implementation of BIM on each project should be planned by the contractor at the beginning of a project life cycle and shall be kept updated throughout the project lifecycle.



- 3.23 All drawings, schedules, simulations, and services required for assessment, review, bidding and construction shall be extractions from BIM models and shall be in compliance with Saudi Aramco design requirements outlined in this document.
- 3.24 All underground utilities shall be 3D objects located at topographic elevations, illustrating nominal sizes and type.
- 3.25 Contractor shall utilize energy modeling and sustainable design software based on BIM data to perform **energy simulation and life cycle cost calculations** to validate their energy modeling. Energy Validation Analysis and software shall be approved by Saudi Aramco.
- 3.26 The delivered IFC at the detail design shall be clash free at the development level of 400. Contractor shall assure constructability by using a Federated Design BIM. Contractor shall conduct **constructability review meetings** with participation of Saudi Aramco at least once during Conceptual Design, Detail Design phases and throughout construction.
- 3.27 The contractor shall provide the **clash-free review** models supported by acceptable resolution report to Saudi Aramco for review and concurrence.
- 3.28 Contractor shall link the BIM models to a scheduling application to create a virtual, visual schedule that depicts construction sequencing and activities to achieve **4D Scheduling and Sequencing**. This 4D model will show the sequencing of activities in space and time and accounting for constraints such as procurement lead time/logistics, resources, spatial constraints, and weather among others to help improve accuracy and to better understand the schedule. 4D is mandatory at the Project Proposal and Detailed Design phases.
- 3.29 Contractor shall be responsible for obtaining, at their cost, the trained personnel, hardware, and software needed to successfully use BIM for the project. Contractor shall also be responsible for accuracy and reliability of all technical disciplines in the integrated BIM models.



4. PROJECT SET-UP FOR BIM MODELING

4.1 General

- 4.1.1 Contractor shall follow SAEP-301 for all units of measure. For annotative precision, the precision for length will have zero decimals places. Angular Dimensioning will have a precision of two decimal degrees (.00) precision.
- 4.1.2 For the BIM origin and coordinates, all models must be in the correct and agreed upon location and orientation in 3D Space (X, Y, and Z coordinates). Contractor shall ensure all BIM team utilize these coordinates. It is crucial Project Points remain static throughout the life of the project. Refer to Section 8 of this appendix for more detail.
- 4.1.3 The contractor shall provide the minimum level of details established in Table “A” above. ISO 19650 and based on British BIM standards PAS 1192-2 (latest) and the US standards American Institute of Architects (AIA) Document E202-2013 shall be used as reference guidelines to comply with by the design and construction teams in addition to the project requirements. The provided contractor’s project LOD matrix in BEP shall be approved by Saudi Aramco project manager.
- 4.1.4 Suitable versions of other pre-requisite software needed for the BIM model as per the compatibility matrix of the BIM vendor shall be used.
- 4.1.5 It is the responsibility of the design contractor to complete all implementation documents and prepare documents as required for stakeholder reviews and final construction documents. The documents shall include shop drawings for fabrication.
- 4.1.6 The construction contractor shall ensure integration of BIM construction schedule and the implementation of Quality Assurance/Quality Control (QA/QC) program to deliver a complete As-built models.
- 4.1.7 Contractor shall develop Model Progression Matrix (MPM) to indicate the LOD for various types of data and disciplines. MPM shall be a part of the project BIM execution plan (BEP).
- 4.1.8 The BEP must define Project North in relation to true North. All BIM data for the project must use these defined directions

consistently.



4.1.9 Abbreviations when used shall be clearly defined and contractor shall ensure compliance to international terms.

4.1.10 Contractor shall provide means of visualization to be used for design review. Those means may include, but not limited to, the following:

- Images (Screen Shots, Renderings)
- Live Animations (Fly-through, Panoramic immersion)
- Federated BIMs in a Read-only format.

It is the Contractor's responsibility to make a free viewer available to Saudi Aramco.

4.1.11 Contractor shall maintain the following Colors for Clash Detection:

- Architecture: White
- Structural Steel: Maroon
- Concrete: Gray
- HVAC Duct: Blue
- HVAC Pipe: Lime Green
- Electrical: Cyan
- Plumbing: Magenta
- Fire Protection: Red
- Pneumatic Tube: Dark Green
- HVAC Equipment: Gold
- Communication Conduit: Light Blue
- Equipment (Medical): Light Green
- Medical Gas: Light Green
- Security Systems: Orange
- Fire Alarm: Fuchsia

4.2 BIM Uses

At a minimum, the BIMs shall be used for design reviews, submittals, and construction documents. Contractor shall detail project BIM uses and what the models will be used to produce during the different design stages of this particular project (DBSP, Project Proposal-IFB, Detailed Design-IFC, and Shop Drawings). This is part of the guide that instructs the project team on modeling requirements and shall be clarified in the BIM Execution Plan.

The BIM uses section shall list all BIM uses for the project and the party, or parties, responsible for completing that use and any output defined for



that use as well as specifying the relevant platform and exchange format for each discipline. It includes the different standards to be adopted for creating, developing and delivering of the relevant BIM model(s), which are a direct implementation of the set BIM uses and the project scope of work.

It is the responsibilities of the contractor to detail the needed BIM uses to achieve and fulfill project scope and meet Saudi Aramco BIM requirements. Project Manager is to make sure and agree to the contractor's inputs.

4.3 PROJECT INFORMATION

BIM authoring tools, data integration, and collaborative team workflow environments shall be used to develop and produce project information and BIM models and documentations as required for submittals.

When initializing the project, contractor shall use the following:

- **Project Number:** This number shall be the facility building number.
- **Project Name:** A description of the building example such as "Aramco Innovation Center". Project naming shall be coordinated with Saudi Aramco BIM Project Management Team.
- **Company Name:** Saudi Aramco
- **Job Number:** Budget Item (BI)I Number
- **Project Location:** address where the building constructed
- **Project and Model Description:** brief information about the project and modeling and what is composed. The full description of the project, milestones / phases and all organizations involved in the project, office locations, documents, roles and responsibilities during the project, including team member names and contact information shall be addressed in BEM plan or a separate BEP project information documentation.

Table B – Discipline Code

Code	Discipline
AR	Architecture
AI	Architectural Interiors
AG	Environmental Graphic Design
CL	Civil
LC	Electrical – Low Current
EL	Electrical – Power & Lighting



Code	Discipline
ME	Mechanical General
MH	Mechanical - HVAC
MP	Mechanical - Plumbing
MF	Mechanical - Fire
MI	Mechanical - Process
SS	Structural-Steel
SC	Structural-Concrete

4.4 PROJECT HIERARCHY

4.4.1 Folder Structure and Naming Conventions

The defined structure shall follow the principles of ‘Work In Progress (WIP)’, ‘Shared’, ‘Published’ and ‘Archived’ segregation of data within a designated set of folders. All project data (excluding a local user’s copy of Central file) shall be held within the standard project folder structure located on a central network server or appropriate Document Management technology. This includes all WIP components or assemblies.

4.4.2 Central Resource Library Folder Structure:

Standard templates, drawing borders, families and other non-project-specific data shall be held within the server based Central Resource Library, with restricted write access.

4.4.3 Local Project Folder Structure

Changes shall regularly be synchronized with the central file(s).

4.4.4 Project Folder Structure

The following folder structure is provided as an example arrangement. Numeric prefixes in the names of folders and files are used for proper sorting of files and folders.



4.4.5 The Models under each Discipline shall be created as per the following guidelines:

Design Area: This could represent a physical facility, e.g., Building code\name or logical breakdown which can act as design areas. The Design Area can be used to subdivide the project into meaningful subfolders.

Model: The models shall be created in respective to project and disciplines, under respective Design Areas. The model number & model descriptions shall be done in such a way that a user can locate a facility item from the correct model and the correct design area with ease.

Model Number: The Model number shall reflect the Project, Discipline, Design Area, and Floor No. and Sequence number. The submittal or project millstone can be added as part of the name for model submittal. For example: an architecture models of project called (Innovation Centre “01210”) in design area (Building Code\name “6154”) in Mezzanine Floor and has sequence of 01 and shall be 01210-B6154-A-M-101. To indicate the submittal phase the model name can be 01210-B6154-A-M-101-30 (for 30%) and 01210-B6154-A-M-101-IFC (for IFC).

Model Description: Two ways can be adopted to give the Model Description. The Suitable one shall be consistently Description, Discipline & Model no. (e.g., Architecture model for Mezzanine floor of Building 6154).



5. NAMING CONVENTIONS

Refer to [Section 10](#) of this standard for the Naming Convention of Mechanical, Electrical, Instrumentations, Piping, and cables.

6. MODELING

Contractor is responsible for the accuracy of the model, data and the Level of Development (LOD) required for all elements(s) or systems(s) in the BIM models.

6.1 Modeling Main Principles

The following main principles shall be observed when creating and using the design components:

- 6.1.1 All components shall reside in the library of the specific project.
- 6.1.2 Components generated during the design development will be stored in the Work In Progress (WIP) area of the Common Data Environment.
- 6.1.3 The intended purpose of the components shall be considered during content creation.
- 6.1.4 The BIM Manager/Coordinator shall assess and verify minimum quality compliance for all new objects to be approved by Saudi Aramco.
- 6.1.5 Components shall be developed with the LOD required at the particular stage of design process. Refer to Table “A”.
- 6.1.6 Further purposes of the BIM will lead to additional specifications of the content, which should be built to suit the purposes of the deliverables. Information can be added to the existing components either by means of creation of **shared parameters** and their assignment to specific categories of elements within the design itself, or by separate addition of these parameters to each library component. **Method that is to be used shall be defined in the BEP.**
- 6.1.7 A corporate shared parameter file is encouraged in order to maintain consistency of variable naming during content creation. Where multiple LODs of the same component do exist, care should

be taken to ensure that the same Shared Parameters are incorporated into the objects, in order to maintain data integrity.

6.1.8 For drawing compilation and preparation for publication can be carried out by fully assembling compilation of views and sheets within the BIM environment.

6.1.9 Drawing sheet composition from within a BIM environment shall be established through the linking of views, callouts and elevations to drawing sheets fully within the BIM authoring software



6.2 Level of Development (LOD)

The Level of Development (LOD) required for elements or systems in the BIM models shall be detailed by the contractor in the BEP plan and agreed by Saudi Aramco.

The model elements shall contain the information and data required at each stage of the project and the BIM modelling process.

The Level of Development (LOD) for each architectural element shall be determined and described within the LOD Definitions/Requirements document or part of the BEP plan.

Contractor shall follow the LOD Definitions developed by the American Institute of Architects (AIA) and be grouped by the key disciplines used in Saudi Aramco construction projects- LOD 100 to LOD 500, as and where applicable.

The minimum level of development shall follow Table-A for the mentioned phase. The final Project backup delivered to Saudi Aramco-EK&RD shall have all the models & related drawings in 'As-built' stage and shall have minimum BIM Level of Development 500 and all model elements shall be field verified.

6.3 LOD Responsibility Matrix

LOD Responsibility Matrix shall be developed to reflect Saudi Aramco requirements for BIM elements presence in BIM models, and the required LOD. LOD Responsibility Matrix shall contain the following information:

Element is required	(Y/N)
Quantity Take-off (QTO)	Typical data that can be extracted from the BIM Model for quantity measurement take off requirements in the BIM PXP
Category Code (CAT Code)	Alphabetic code for each type of model element. Can be used for clash analysis, QA and model reviews. This code may be replaced by a Unifomat code
AUT	Model Author
Project Phase	DSPB, Project Proposal, Detailed Design, Shop Drawings
LOD	Level of Development required
Site Model	Site Model
Discipline Models	Architecture/Structure/Mechanical/Ventilation/Air-Conditioning/Electrical/Communication/Building Systems Models. Any other Discipline model required by Saudi Aramco



6.4 Project Model Configuration

The combination of scale, density, and level of detail for building information models dictates certain models must be divided, in case of large scale BIMs. The BIM project can be divided into multiple models, in case essentially required and agreed by the assigned Saudi Aramco project manager, to accommodate scope of work, team structure, model performance and overall collaboration.

The objective is to break the project into as few models as possible while maintaining targeted open and synchronizations times for the minimum computing hardware. The models will be divided based on disciplines, model's function and to accommodate the optimum size. When BIMs are divided, the continual and periodic linking of neighboring models is necessary as well as linking the corresponding models of other disciplines. Mutually developed and well managed work sets play an important role here in maintaining practical file open times for all teams.

6.5 BIM Procedure

BIM Procedures establish the processes that define the preparation of the BIM Model and govern the validity and the adequacy of the included technical data and other modelling information and references. BIM Procedures shall be established by Contractor and approved by Saudi Aramco.

The following items shall be applicable to any BIM project:

- BIM Origin Point & Orientation
- Modeling Methodology and Model Division
- File Naming Convention and Model Units
- Layer Coding and Naming Convention
- Annotations, Dimensions, Abbreviations and Symbols
- IT Hardware & Software Solutions and Upgrades
- Information Exchange Format
- Data Security & Back-up

BIM models process shall be detailed by the contractor in the BEP plan and agreed by Saudi Aramco.



6.6 Collaboration Plan and Coordination Process

Contractor shall coordinate project collaboration environment for document management and file sharing, reviewing tools, project communication, and a built-in viewer for reviewing 3D BIM models.

The following requirements shall be met as minimum for collaboration between the design and the construction contractors:

- Contractor shall provide Collaboration Plan and have it approved by Saudi Aramco. The collaboration process shall allow other project's team members for accessing up-to-date model and share required BIM models, drawings, and documents for completing work assigned.
- Contractor shall provide a communication plan detailing the required project meetings and workshops including phase of activity, frequency, and attendees. The types of meeting shall be for activities such as but not limited to, modeling status, project coordination, clash detection and other 3D models coordination's and reviews. The workshops and meetings shall cover all project phases. The description collaboration process plan and communication plan shall be part of the contractor's BEP plan.
- The Contractors BIM Manager shall develop a BIM folder structure in coordination with the Design Teams BIM Manager to be utilized in the designated project server or portal for access by the entire project team for uploading project data and the 3D models produced for work members from Design/Construction and Sub-contracting Teams. These BIMs will be accessible to an authorized team members for individual coordination purposes on a trade by trade basis.

- Contractor shall maintain accurate As-built Model and ensure clear and smooth data/file exchange coordination process between the design team and the construction trades. The Contractor is responsible to maintain project folder and project sharing environment that is in-line with all parties working in all phases of the projects. Such process shall be detailed in the BEP plan and approved by Saudi Aramco.



6.7 Discipline Modeling Requirements

It is the responsibility of the Contractor to meet and fulfill the project scope requirements set by Saudi Aramco and achieve a complete BIM models.

BIM Modelling at each stage of the project and level of development of the elements produced at each stage shall be carried-out as specified in the BIM Execution Plan (BEP). The resulting outcome of the BIM Modelling at each stage of the project shall be accessible to reviewers during project BIM reviews to all participants in the Project Review process from all involved Disciplines (Architectural, Structural, Mechanical, Electrical, Civil), as well as other potentially involved specialized disciplines. Reviewers shall be able to access via the review tools within the Saudi Aramco project review System for the review purposes and comments specific for that discipline.

The general Discipline Modelling Requirements could be amended from time-to-time by Saudi Aramco, depending on the required BIM modelling detail for a particular project.

Discipline Modelling Requirements for existing and/or additional element types may be added or omitted by Saudi Aramco for a specific discipline.

Discipline Modelling Requirements shall include detailed requirements for modelling the applicable types/groups of elements for that discipline.

Discipline Modelling Requirements for the disciplines conventionally involved in a Building Construction project and the BIM process shall include the following items to be modeled as a minimum:



6.7.1 Architecture

- 6.7.1.1 Architectural models must include the BIM Objects relative to floors, exterior and interior walls and partitions, roofs, vertical transportation, windows, doors, stairs, ramps, railings, ceilings, grilles & gates, interior specialties, etc.

- 6.7.1.2 Required structural blocking (such as for TV, monitors) must be modeled for quantities, size, shape, and location, etc.
- 6.7.1.3 Major structural components from the Structural model (including but not limited to structural walls, floors, roof structure, columns, and foundations) shall be referenced. Interiors Model, Equipment Models, and appropriate building equipment and systems models (including mechanical for louvers), and others as needed to coordinate the work shall be referenced
- 6.7.1.4 **Interior Finishes:** Interior finish plans, ceiling plans, elevations, and intelligent scheduling of objects/elements must be used to convey materials and finishes in a separate Interiors model, associated with the architectural model (and others as required)
- 6.7.1.5 Interior Finishes must be included as a part of the room properties. All materials that are representative of a system **greater than ¼ inch in thickness** s be included in the model as 3D geometry (example: wall protection, interior cladding such as stone, masonry, glass, metal, or wood paneling)
- 6.7.1.6 **Walls:** Wall bases shall be modeled (based on dimension and type) where elevated. Wall finishes greater than ¼ inch thickness must be modeled for coordination and clearance. Non- geometric data (e.g., actual material specified) shall be included as part of the room finish tag on the architectural finish plans.
- 6.7.1.7 **Modular Furniture:** Manufactured modular furniture selected for the design-intent documents shall be modeled to correct dimensions (length/width, depth, and height) and linked to the basis-of-design cut sheet for the item
- 6.7.1.8 **Ceilings:** All ceiling materials, other than paint, shall be modeled and included as part of the overall room finish tag
- 6.7.1.9 **Stairs:** All stair finishes shall be scheduled in the model

6.7.2 Structure



- 6.7.2.1 Structural models must be the basis of evaluating and analyzing the building structure, and shall include all structural objects, elements, components and systems.
- 6.7.2.2 All material and material properties must be included for each object.
- 6.7.2.3 Building structure and geometry must be accurately defined and labeled for foundations, subgrade enclosures, slab-on-grade, superstructure, and exterior vertical enclosures and roofs.

6.7.3 Mechanical, Electrical, Plumbing, Fire Protection, Technology Systems

- 6.7.3.1 Mechanical, Electrical, Plumbing, Fire Protection, and Technology systems must be in their own discipline models, referenced to the Architectural model and other discipline models as needed.
- 6.7.3.2 All system models must include all equipment necessary for operations, including (but not limited to) boilers, chillers, geothermal and solar energy systems; pumps and piping distribution systems (including modeling for pipe slope and insulation), water- side terminal units; fans, air handlers, air distribution and evacuation systems (including modeling for duct and equipment insulation), air-side terminal units, variable air volume - VAV boxes; electrical feed and distribution systems transformers, electrical panels and switchgear, lighting, emergency circuitry, emergency generators; all public utility systems from tap, all control systems, data and phone wiring and terminal devices, data switches, data rooms, etc.
- 6.7.3.3 **Mechanical:** All components of the mechanical systems must be modeled accurately, and include the necessary space reservations for appropriate access during maintenance and replacement. Louvers should be modeled as a part of Mechanical.
- 6.7.3.4 **Electrical:** The Architectural, Mechanical, and Electrical models must reference each other and be a part of the Design Coordination to eliminate any mismatches between the models.

6.7.3.5 **Plumbing for Domestic (Potable) Water:** All of the supply and return elements, components, and distribution systems of the Domestic Water System must be modeled regardless of size, with properties for the name of the system (e.g., Domestic Water), material (copper, PVC, etc.) diameter of pipe, direction of water flow, design temperature ranges, filter locations and type, color coded differently for supply and return, and other identification necessary to be able to view the Domestic Water System independently from other plumbing systems. The Domestic (Potable) Water system shall be identifiable and manageable for safety during facility management operations.

6.7.3.6 **Fire protection models:** must include fire ratings, sprinkler medium, pressure and flow volume

6.7.3.7 All riser diagrams shall be model-based



6.7.4 Site Civil

6.7.4.1 All features and information typically provided in site plans must be provided. This includes roadways, walks, physical features, topography (contours), location, and rim and invert

6.7.4.2 Elevation levels of underground utilities, soil / geotechnical conditions, etc. AE modeling of subsurface utilities and conditions must be labeled as FOR INFORMATION ONLY

6.7.4.3 Buildings must be minimally modeled for site civil work but must reflect the accurate location of outside proposed building walls and any utility penetrations through floor slabs and walls below ground.

6.7.4.4 Site elements requiring maintenance must be labelled separately.

6.7.4.5 Underground Site Utilities- Objects must be modeled in 3D for civil underground utilities and site work, both existing and proposed to identify their type. All properties of the utility shall be included.

6.7.4.6 Modeling of Underground Site Utilities shall extend to 1,500 mm (five feet) beyond the project construction



boundaries and will connect with the site and building utility services, if such are present.

6.8 4D Scheduling and Sequencing

The below table defines the minimum primary elements that are required in a 4D simulation but are not limited to:

Discipline	Minimum Required
Structural Systems	All structural framing components including foundations, grade beams, columns, load bearing walls, floor and roof decks and support
Exterior building envelope	Stud walls, Exterior Panels and assemblies, curtain walls, openings, glazing
Interior partitions	Main plumbing walls and wall assemblies
Mechanical system	Main Ductwork and Equipment, (Separated by floors)
Electrical	Main runs and Equipment, Separated by floors
Roof systems	Roof Assemblies, Major Equipment, Openings
Site work and ground plane	Excavation work, footings, foundations, on-grade Slab
Plumbing	Main Connection lines from site, main plumbing lines

6.9 5D Estimation

The complete Project Cost Estimates/ Priced Bill Of Quantity shall include quantities derived from both the BIM data and conventional methods as appropriate and necessary. The cost estimation shall be prepared from the Project Team's BIM Process.

The design team shall extract square meter and system information using BIM Authoring software and other BIM integrated tools to support comparative cost analysis. The output result shall be able to be converted to spreadsheets. The Schematic Design (SD) phase given the low level of development of the BIMs and used as a validator for Probable Cost Estimates.

As the BIMs LOD progress through the design phases, the design team shall use the quantities in the BIMs as a validator for their Estimates. It will be the responsibility of the design team to specify when they are writing the BEP plan what method and software they will use to perform this task. Below table indicates minimum requirements:

Stage	Minimum Required
-------	------------------

Planning	Probable Cost
Schematic Design	Probable Cost & quantity Takeoff based on Square Footage
Concept Design	Probable Cost & quantity Takeoff based on available BIMs at LOD 200
Detail Design	Probable Cost & quantity Takeoff based on available BIMs at LOD 300



6.10 As-built and Advanced Modeling Requirement

6.10.1 The provided information for the BIM models dimensions in this documents defines a minimum of “As-built” Saudi Aramco requirement (LOD 500).

6.10.2 Project requirements may request more to advanced level such as LOD 600 and acquire 6D, sustainability assessment, or even 7D for facility management. The requirements for advanced modeling shall be detailed in the owner scope requirements.

6.10.3 Contractor shall continue development of the models created in the Design Development Phase. Maintain parametric links within the respective models to enable automatic generation of all plans, sections, elevations, custom details, schedules, and 3D views. All information needed to describe the execution documents shall be graphically or alphanumerically included in and derived from these models only.

Table below provides the deliverable formats required according to project phases and LOD:

Project Phase	LOD Level	Deliverable Formats
Concept Design	100	Native, Industry Foundation Class, Review Format, PDF
Design Development	200	Native, Industry Foundation Class, Review Format, PDF
Tender Design	300	Native, Industry Foundation Class, Review Format, PDF
Construction/Fabrication	400	Native, Industry Foundation Class, Review Format, PDF, COBie data set deliverables
As-built / Record Documents	500	Native, Industry Foundation Class, Review Format, PDF, COBie data set deliverables.

6.10.4 BIM models shall be submitted at 30%, 60%, 90%, Issued For Construction (IFC) and 100% As-built with all drawings matching with LOD as per this appendix and BEP.



6.11 Quality Control and Clash Detection

The design and construction teams shall take full responsibility to utilize an efficient processes for reviewing project works and provide BIM quality end results. All conflicts and interferences shall be identified within the BIM and/or BIMs, which would adversely affect the work described within the Construction Documents, shall be rectified prior to the final submission of the 100% BIM models and related drawings to Saudi Aramco project manager for review and acceptance.

6.11.1 At a minimum, the Design Team shall use automated conflict checking software to identify coordination issues within and between the BIMs that would adversely affect the execution of the work required by the Contract Drawings during and at the conclusion of 100% Construction Drawings.

6.11.2 The design team shall, at a minimum, use the Interference Check Tool on a routine basis during and at the conclusion of each Design Phase and or Sub-Phase, and as per their approved “Quality Control Program”.

6.11.3 It is the design and construction Team’s responsibility to conduct and manage an adequate and thorough clash detection process so that all major interferences between building components are detected and resolved before construction begins. It shall be the goal of the Design and construction teams to reduce the number of changes during construction due to major building interferences to zero.



- 6.11.4 The design and construction Team's BIM Managers shall assemble a composite BIM from all of the BIMs from each design discipline for the purpose of performing a visual check of the building design for spatial and system coordination. Vertical shafts should also be reviewed to ensure that adequate space has been allocated for all of the vertical mechanical systems and that all of the shafts line up floor to floor. Prior to each scheduled coordination meeting, an updated clash report will be issued by the Construction Team BIM Manager to the technical discipline consultants.
- 6.11.5 Coordination software shall be used for assembling the various design BIMs to electronically identify, collectively coordinate resolutions, and track and publish interference reports between all disciplines. The technical disciplines shall be responsible for updating their BIMs to reflect the coordinated resolution.
- 6.11.6 The Project Team shall review the model and the clash reports in coordination meetings on a regular, as-needed, basis throughout the design phases until all spatial and system coordination issues have been resolved.
- 6.11.7 During the construction phase, the accuracy of fabrication BIMs shall be verified. Prior to each fabrication submittal for approval, fabrication contractors shall submit their BIMs to the Construction Team BIM Manager for integration and clash detection / coordination and resolution.
- 6.11.8 Internal clash resolution, design consultants and subcontractors who are responsible for multiple scopes of work are expected to coordinate the clashes between those scopes prior to providing those BIMs to the appropriate Design/Construction BIM Manager for spatial and system coordination.
- 6.11.9 Contractor shall define D4M reviews (Design for Maintenance) in the BEP plan and incorporate them into constructability reviews. Reviews should address accessing at a minimum: all asset types requiring COBie data set deliverables.

7. DRAWINGS TO BE GENERATED



The drawing types that can be generated from the approved software are, but not limited, as the types mentioned in the below table. Any drawing type required by the proponent from the below table shall be generated using the approved software.

INDEX	DRAWING TYPE	DESCRIPTION
A	EQA	EQUIPMENT ARRANGEMENT / LAYOUT / LOCATION / LEGEND
L	ISO	ISOMETRIC PIPING DETAIL/ISOM
	PDT	PIPING SECTION/DETAIL/ELEVATION
	PPL	PIPING PLAN/LAYOUT/ARRANGEMENT
	PPL	PIPELINE ROUTING (ABOVE/UNDER-GROUND/SUB-MARINE)
		HVAC LAYOUT/PLAN/ARRANGEMENT
		HVAC DETAILS
M		
	SDT	PLAN/SECTION/ELEVATION/DETAIL
	SDT	STRUCTURAL ELEVATION/LAYOUT/PLAN
	SDT	WALKWAY PLAN/SECTION/ ELEVATION
	SDT	ALL DRAWINGS RELATED TO STRUCTURAL DETAILS
	ARC	WALLS/FLOORS DETAILS
	ARC	ARCHITECTED LAYOUT/PLAN/ARRANGEMENT
J	RAK	INSTRUMENT LAYOUT (if applicable)
P		
	CBL	CABLE TRAY/RACEWAY PLAN/LAYOUT
	CBL	CONDUIT LAYOUT
	CBL	CONDUIT RACEWAY PLAN/LAYOUT
	CBL	CONDUIT & JUNCTION BOX ARRANGEMENT

8. GEO-REFERENCE

- 8.1 The design team is required to geo-reference building information models, site plans and associated construction drawings to provide projection and coordinate system information necessary to ensure interoperability and display in real world geographic coordinates within existing Geographic Information Systems (GIS).

- 8.2 Final models, site plans and associated construction drawings shall be delivered based on Universal Transverse Mercator (UTM) coordinate system and Zones (36-40).
- 8.3 Projects located in Saudi Arabia; shall utilize the International 1924 Ellipsoid Saudi Aramco Ain Al Abd (1970) Horizontal Datum and on the SAVD (1978) Vertical datum, and; shall employ measurement units appropriate to the project's scale and design in Meters per Saudi Aramco Engineering Standard SAES-A-100 "Survey Coordinates, Datum, and Data Formats".
- 8.4 Further clarification related to the Geo-References, refer to Engineering Support Department/Geomatics Services Division (GSD), as it is responsible for coordinate systems, horizontal and vertical datum, datum transformations and data formats that will be used in engineering, design, construction, surveying, mapping, charting, and drawings of all Saudi Aramco facilities.



9. LASER SCANNING

Where laser scanning is planned in BIM project, scanning tolerances, file compatibility formats, and transfer methods shall be documented and coordinated with Geomatics Services Division (GSD). Laser scanning, in case required in BIM project, shall be detailed in the BIM Execution Plan by the contractor and approved by GSD and Saudi Aramco BIM project manager.



10. PROJECT DELIVERABLES

Contractor shall update their respective models with recorded changes (record drawings) before any submittals. Any 2D drawings effected shall be reproduced in their requested formats. It is mandated by Saudi Aramco that the BIM final models shall be cleaned of extraneous objects or/and other content that not needed and were used during development of the As-built models. All models and files shall be submitted in native software files, Industry Foundation Class and PDFs.

All BIM submissions to be provided in three formats: native format, which depends on the tool selected by the author and approved by EK&RD, PDFs, and the Industry Foundation Class format. BIM submissions shall comply with Saudi Aramco handover project review milestones (30%, 60%, 90%, Issued For Construction (IFC) and As-built Final). The contract has to submit in both the native and Industry Foundation Class formats at all stages of the facility lifecycle - from planning through design, construction and operation (including As-built or record BIMs), and into operations.



All BIM record and facilities models, drawings, tender packages, and documentations shall be provided by the contractor project team in As-built state as per the tables below:

Milestones	Deliverable
Contract Award	BEP Plans (approved by Saudi Aramco)
Conceptual Schematic Phase	Architectural Massing Model Preliminary Energy/ Solar Orientation Analysis
Advanced Schematic Design Phase	Architectural Model Schematic Energy Model Program and Space Validation Massing Model Civil Model COBie Data and Asset Worksheets
Design Development	Architectural Model Civil Model(s) MEP Model(s) Structural Model Program Validation Report Discipline Interference Reports Sustainable Design and LEED Credit Documentation COBie Data and Asset Worksheets
Construction Documents	Architectural Model Civil Model MEP Model(s) Structural Model Pre-bid Collision Report Phasing Models (if applicable) COBie Data and Asset Worksheets
Bidding	Federated Model (Single integrated database) Design BIMPxP
Construction Phase	Coordination Models Collision Reports Architectural MEP/ FP Models Structural Models Fabrication Models (if applicable) Phasing Models COBie Data and Asset Worksheets
Project Close-out	Record Model - Architect As-built Model - clashes detected and verified, and model take-off Record Documents Project Drawings (Native and PDF format) O&M Manuals As-built Drawings COBie Data and Asset Worksheets

Revision History

11 August 2021	Editorial revision to fix incorrect referencing in standard's appendix.
26 March 2020	Editorial revision.
29 October 2019	Addition of Appendix-H for Building Information Modeling (BIM) specification.
25 May 2014	Revised the Next Planned Update, reaffirmed the content of the document, and reissued as major revision.