## Power Management System Revision History

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| --- | --- | --- | --- |
| Version | Date | Author | Changes Made |
| 1 | 2014/06/23 | Torstein Ingebrigtsen Bø | Initial |
|  |  |  |  |

## Model Hierarchy

The block consists of 3 “From xxx” blocks, these gets the data from the connected elements via from blocks. The “from” blocks are established automatically via the “updateDiagram” script. Internally in some of the blocks is a for-each block used to rearrange the signal to vectors. These signals are then fed to the “Power Management System”-subsystem which calculates the power available and fast load reduction. This is done in a C++ implementation. Similarly is a block called “Genset Control” used to calculate the no-load-frequency and no-load-voltage for the generator set. The last block, named “Log Power” is used to log the total power.

## Description

This block is used to calculate the power available and fast load reduction signal. The Power Management System (PMS) divides loads into three groups:

* Low priority loads, first load to reduce if there is too little available power.
* Dynamic Positioning (DP) load, loads from thrusters.
* High priority loads, loads which should be reduced after the DP has reduce its power.

From each generator set a power available signal is sent to the PMS. This is the power the generator set can produce instantly. For each bus this is summed over each connected generator set. This is then allocated back to the loads. First “High priority loads” get as much as they have desired (but not more than available power), the rest is first then given to DP (which is combined to one load per bus), before eventually “low priority loads” get the remaining load. The excessive power available is shared equally between all three load groups, if there is more power available than desired.

Fast load reduction is also implemented. This gives a signal to the thruster drives to limit their power to the calculated value. Later this limit is increased linearly with time; the idea is that the power available should reduce the total thruster load (which is a slower system since thruster allocation is involved).

These fault detection uses fast load reduction:

* Opening of bus tie breakers. After a bus tie breaker has opened the two new busses will have a different load sharing than before the fault. The generator set will therefore get a new load sharing. To make sure that the generator set is not temporarily overloaded (which may lead to a under frequency) are the load of the thruster reduced with the same amount as the extra power due to the new load sharing.
* Opening of generator set breaker. After a trip of a generator set will the remaining generator set take the power that was previously generated by the disconnected generator set. The thrusters connected to the same bus as the failed generator will therefore reduce their load with the same amount as the generator was producing.

To allocate power available the PMS need to know how much each consumer desires. For both low and high priority loads, this is set by the consumer. For DP/thruster, the desired power is set to powerDesiredDPBias\*ratedPowerOfAllThrusters

+ powerDesiredDPGain\*consumedPowerByThrusters.

## How to build

1. Make sure that Matlab is installed with a compiler
2. Open directory “%MarinePowerSimulatorRoot%/PowerManagementSystem”
3. Run “make”

### Implementation details

The main c++ class is PowerManagementSystem. It requires a PowerPlant object which consists of a mirror of all electrical components. See doxygen documentation for more details about documentation.

## Parameters (include parameter identification)

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Dimension | Unit | Description |
| PMS\_sampling\_time | 1 | s | Sampling time of PMS |
| reactionTimePowerAvaialble | 1 | s | Time from a fault is detected until the Power available signal is reduced |
| rampTimePowerAvaialble | 1 | s | Time from power is reduced until the power available is restored back to the limits set by generator sets |
| FlrRestoreTime | 1 | s | Time from a fault is detected until the fast load reaction signal is reduced |
| FlrRampTime | 1 | s | Time from power is reduced by FLR until the flr is restored back to rated values of generator set |
| nSwitchboard | 1 | - | Number of switchboards |
| nThrusters | 1 | - | Number of thrusters |
| powerDesiredDPBias | 1 | - | See above |
| powerDesiredDPGain | 1 | - | See above |

## Input

### From

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Dimension | Unit | Description | From |
| PowerDesiredLowPriorityX | 1 | W | Desired power available for low priority load X | Load others X |
| PowerLowPriorityX | 1 | W | Consumed power by low priority load X | Load others X |
| PowerDesiredHighPriorityX | 1 | W | Desired power available for high priority load X | Load others X |
| PowerHighPriorityX | 1 | W | Consumed power by high priority load X | Load others X |
| ThrusterX | 1 | Bus:ThrusterBus | Data from thruster X | Thruster X |
| GeneratorsetX | 1 | Bus:Genset2PMS | Data from generator set X | Generatorset X |
| nBus | 1 | - | Number of electrical bus | Switchboard2Bus |
| switchboard2bus | nSwitchboards | - | Switchboard ID to bus ID mapping | Switchboard2Bus |

## Output

### Goto

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Dimension | Unit | Description |
| powerAvailableDP | nSwitchboards | W | Power available to each BUS for use by DP |
| FastLoadReductionThrusters | nThrusters | W | Fast load reduction limits for thrusters |
| powerAvailableLowPriority | nSwitchboards | W | Power available for low priority for each switchboard |
| powerAvailableHighPriority | nSwitchboards | W | Power available for high priority for each switchboard |
| GensetWNL | nGeneratorset | - | No-load frequency for generator set |
| GensetVNL | nGeneratorset | - | No-load voltage for generator set |

## Limitation

Limited number of fault handling scenarios is implemented. The output can be fixed if faults are not of interest.

## Validation

N/A

## Comments

## Reference

A. K. Ådnanes, *Maritime Electrical Installations and Diesel Electric Propulsion*. Oslo, Norway, 2003,