# Base Load Power Hub (BLPH)

## Safety Controller loading estimation

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ROSETTI MARINO

| | |
|---|---|
| 1 | NO COMMENTS - APPROVED - WORK MAY PROCEED |
| 2 | MINOR COMMENTS - REVISE AND RESUBMIT - WORK MAY PROCEED |
| 3 | MAJOR COMMENTS – REJECTED – DO NOT PROCEED |
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## Revision / Change Log

| Rev. | Description |
|---|---|
| 00 | Issue for Information (IFI) |
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# 1 INTRODUCTION

## 1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

### 1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.




*Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map*

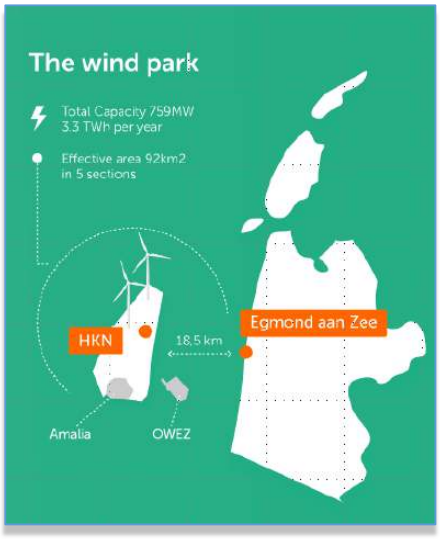



*Figure 2 - Wind Park Details*

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

### 1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

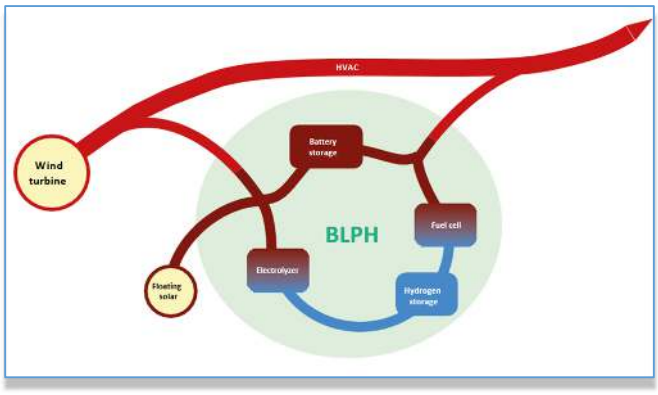



*Figure 3 – BLPH Concept*

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

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# 2 DOCUMENT SCOPE

Scope of this document is to provide an approximate calculation for controller loading for SIS.

This document can be taken as a reference for detail engineering based on controller loading calculation provided. Refer to attachment-1.

## 2.1 REFERENCES

| Doc. No. | Description |
|---|---|
| K559-2254-IC-SPE-001<br>YEF240101055_rev00 | System specification for Main Automation ContractorYokogawa Technical Proposal - Crosswind BLPH Project |
| K559-2254-IC-PHI-001 | Control System Philosophy |
| 1724000594-IN-DD-00015 | System Architecture |
| 1724000594-IN-LIS-00004 | PCS and Safety System IO List (HW and SW) |
| 1724000594-IN-DG-00021 | SAFETY SYSTEMS CABINETS (SIS AND FGS) WIRING DIAGRAMS AND TERMINAL STRIPS |
| 123A90-DDL-IN-LIS-40089 | Instrument I/O ListIODB |
| GS 32P06D10-01EN | ProSafe-RS Safety Node Unit, Duplexed Safety Node Unit (for N-IO/FIO, Rack Mountable Type) |
| GS 32Q06K10-31E | ProSafe-RS Safety Node Unit (Rack Mountable Type) |
| GS 32Q06L11-31E | ProSafe-RS ESB Bus Coupler Module |
| GS 32Q06K30-31E | ProSafe-RS Analog I/O Modules (for FIO) |
| GS 32Q06K40-31E | ProSafe-RS Digital I/O Modules (for FIO) |
| GS 32Q06M10-31E | ProSafe-RS/ProSafe-RS Lite Cable |
| GS 32Q06L20-31E | ProSafe-RS/ProSafe-RS Lite Terminal Boards/Relay Boards |
| TI 32P01A10-01EN | Safety Instrumented System ProSafe-RS System Overview |

*Table 1 - Reference Documents*

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## 2.2 DEFINITIONS AND ABBREVIATIONS

| | |
|---|---|
| COMPANY or Client (CPY): | Crosswind |
| CONTRACTOR (CTR): | ROSETTI MARINO S.p.A. |
| PROJECT: | HOLLANDSE KUST NOORD WIND PARK Project |
| IO | Input/Output |
| SCS | Safety Controller System |
| SIS | Safety Integrated System |
| FGS | Fire and Gas Detection System |

*Table 2 - Definitions and Abbreviations*

## 2.3 ASSUMPTIONS

NIL

## 2.4 BASIS OF CALCULATION

- Controller loading is done based on IODB 123A90-DDL-IN-LIS-40089
- Only 1 SCS Link transmission is configured between SIS and FGS.

## ATTACHMENT-1

Safety Controller loading estimation-SIS

Safety Controller loading estimation-FGS

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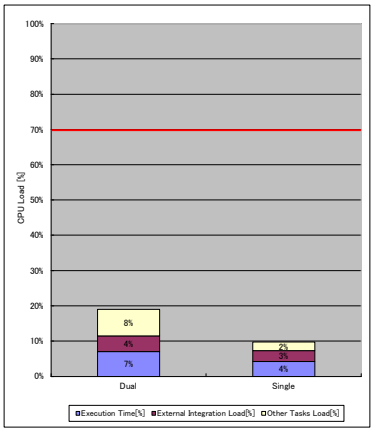
**This tool is for SCS R4.01.00 or later with S2SC70**

| Item | Input Parameters | | |
|---|---|---|---|
| Common | Scan Period [ms] | 300 | |
| I/O (The sum of I/O groups) | Number of IOM *11 | 10 | (Read Only) The maximum number of IOM is 110. |
| | N-IO (Single) | 0 | (Read Only) |
| | N-IO (Dual-redundant) | 0 | (Read Only) |
| | FIO (Single) | 0 | (Read Only) |
| | FIO (Dual-redundant) | 10 | (Read Only) |
| | Number Of ALR1x1/ALE111 for Subsystem comm. | 0 | (Read Only) |
| | Number Of CommWord | 0 | (Read Only) |
| | Number Of S2LP131 for Safety Subsystem comm. | 0 | (Read Only) |
| | Number Of Safety Subsystem CommWord | 0 | (Read Only) |
| | Number Of Safety Device for Safety Subsystem comm. | 0 | (Read Only) |
| N-IO group1 | Maximum Extention Distance[km] *7 | 0 | Classify the N-IO nodes into three or less groups as to the maximum length of optical cable. Input necessary parameters in each group. In case of no Optical N-ESB Bus Repeaters, input 0 to Maximum Extension Distance. |
| | IOM (Single) *1 | 0 | |
| | IOM (Dual-redundant) *1 | 0 | |
| N-IO group2 | Maximum Extention Distance[km] *7 | 0 | |
| | IOM (Single) *1 | 0 | |
| | IOM (Dual-redundant) *1 | 0 | |
| N-IO group3 | Maximum Extention Distance[km] *7 | 0 | |
| | IOM (Single) *1 | 0 | |
| | IOM (Dual-redundant) *1 | 0 | |
| FIO group 1 | Maximum Extention Distance[km] *7 | 0 | Classify the FIO nodes into three or less groups as to the maximum length of optical cable. Input necessary parameters in each group. In case of no Optical ESB Bus Repeaters, input 0 to Maximum Extension Distance. |
| | N-IO Node Connection (True/False) *10 | FALSE | |
| | IOM (Single) *1 | 0 | |
| | IOM (Dual-redundant) *1 | 10 | |
| | Number Of ALR1x1/ALE111 for Subsystem comm. *5 | 0 | |
| | Number Of CommWord *6 | 0 | |
| | Number Of S2LP131 for Safety Subsystem comm. | 0 | |
| | Number Of Safety Subsystem CommWord *12 | 0 | |
| | Number Of Safety Device for Safety Subsystem comm. *1 | 0 | |
| FIO group 2 | Maximum Extention Distance[km] *7 | 0 | |
| | N-IO Node Connection (True/False) *10 | FALSE | |
| | IOM (Single) *1 | 0 | |
| | IOM (Dual-redundant) *1 | 0 | |
| | Number Of ALR1x1/ALE111 for Subsystem comm. *5 | 0 | |
| | Number Of CommWord *6 | 0 | |
| | Number Of S2LP131 for Safety Subsystem comm. | 0 | |
| | Number Of Safety Subsystem CommWord *12 | 0 | |
| | Number Of Safety Device for Safety Subsystem comm. *1 | 0 | |
| FIO group 3 | Maximum Extention Distance[km] *7 | 0 | |
| | N-IO Node Connection (True/False) *10 | FALSE | |
| | IOM (Single) *1 | 0 | |
| | IOM (Dual-redundant) *1 | 0 | |
| | Number Of ALR1x1/ALE111 for Subsystem comm. *5 | 0 | |
| | Number Of CommWord *6 | 0 | |
| | Number Of S2LP131 for Safety Subsystem comm. | 0 | |
| | Number Of Safety Subsystem CommWord *12 | 0 | |
| | Number Of Safety Device for Safety Subsystem comm. *1 | 0 | |
| IEC Logic *2 | POU Large | 4 | (According to the input POU numbers, the total IO channels processed by all POUs are presumed at least 128 ch, at max 236ch.) |
| | POU Middle | 10 | |
| | POU Small | 16 | |
| | Locking of Internal Variables (True/False) *9 | TRUE | |
| CENTUM Integration | External Scan Period [sec] | 1 | |
| | Mapping Blocks | 0 | |
| | Mapping Elements | 0 | |
| Modbus Slave | Number of Connection *4 | 0 | |
| SCS Safety Communication | Number of Station | 1 | |
| | Number of Data for each station *3 | 18 | |
| SCS Link Transmission | Number of Station for receiving data *8 | 0 | |

**Main CPU Performance**

Main CPU Performance

| | Estimated Performance | |
|---|---|---|
| | Dual | Single |
| CPU Idle Time[%] | 81% | 90% |
| CPU Idle Time[sec/60sec] | 49 | 54 |
| Total Load[%] | 19% | 10% |
| Total Execution Time[ms/scan] | 57 | 29 |
| Execution Time[%] | 7% | 4% |
| Execution Time[ms/scan] | 21 | 13 |
| External Integration Load[%] | 4% | 3% |
| External Integration Exec Time[ms/scan] | 13 | 9 |
| Other Tasks Load[%] | 8% | 2% |
| Other Tasks Exec Time[ms/scan] | 23 | 7 |




**Limitation on R4.01.00:**
When the CPU load or I/O coprocessor load exceeds 70%, the input processing of SCS is stopped. This causes all the input status to become BAD.
This occurs only when the scan period shorter than 250ms is specified.
This limitation was released with R4.01.01 and R4.02.00.

*1 Input the number of the single IOMs and the number of the pair of dual-redundant IOMs respectively.
ex. If two DI modules are used dual-redundantly, enter 1 into the IOM (Dual-redundant) cell.

*2 Input number of Programs which classified it's complexity.
See below complexity guide. See also the "Example of complexity of a POU" sheet.

| | Description | Channels | Size |
|---|---|---|---|
| Large | VOTER, SYS_*,... Rich | 10+ | 2+ KB |
| Middle | AI/DI mixed, Ordinary Logic | 4 to 8 | 1 to 2KB |
| Small | DI Rich, Simple Logic | 1 to 6 | 1- KB |

1 POU is estimated to have the following resources approximately.
5 ch/POU (In case of 12ch/IOM)
0 Mapping block/POU

*3 Input average number of data for each connection.
ex. If SCS0101 communicates SCS0102 with 50 send data and 50 receive data,
then input "50" for this parameter. In this case, input "1" for the "Number of Station".

*4 Input number of Modbus Slave connection (sum of ALR1x1 ports and ALE111 connections)
whose access period is faster than 100ms.
(If the access period of a Modbus Slave connection is longer than 100ms,
the load of the Modbus Slave connection is negligible.)

*5 Input the number of ALR1x1/ALE111 for SubSystem Communication.
ex. If one ALR1x1 for two PLCs is implemented for SubSystem connection,
input "1" for the "Number Of ALR1x1".
If two ALR1x1s for redundant configuration are implemented for SubSystem connection,
input "2" for the "Number Of ALR1x1".

*6 Input the total word number to be communicated by SubSystem Communication.
(A word is two bytes.)
ex. If the SCS reads 50 words data from PLC1, and writes 50 words data to PLC1,
and reads 50 words data from PLC2, input 150 for the "Number Of CommWord".

*7 Input the following data.
No Optical ESB Bus Repeaters : 0
Using Optical ESB Bus Repeaters :
Maximum length (km) of optical cable from the CPU node to the farthest I/O node. The length is up to 50km.

For better accuracy, input the calculated distance according to the following formula.
$\Sigma i\ Yi*Xi/Z$
i= from 1 to number of the I/O nodes extended by the Optical N-ESB/ESB Bus Repeaters
Xi = number of the IOMs mounted in the I/O node i
Yi = length of optical cable from the CPU node to the I/O node i (km)
Z= Total number of the IOMs in the group

*8 ex. If the SCS receives the link transmission data from 3 station, input 3 into the parameter.
Number of Station includes SCS and FCS.
If the SCS receives the link transmission data from 2 SCS and 3 FCS, input 5 into the parameter.

*9 Set "True" when "Locking of Internal Variables" on SCS Constants Builder is set to "Enable".
If you set "Enable" to "Locking of Internal Variable", the Execution Time of SCS increases.
Please refer to "Engineering Guide Vol. 1" (IM 32P01C10-01EN) in detail.

*10 Set "True" if N-IO node is connected to the path from the CPU node to the FIO node.
If you set "True" to "N-IO Node Connection", the load about the optical ESB bus commuication increases.

*11 Note that "Number of IOM" is the sum of the following:
"N-IO (Single)", "N-IO (Dual-redundant)", "FIO (Single)" and "FIO (Dual-redundant)".
This is not including the number of ALR1x1/ALE111 for Subsystem communication or Modbus slave communication (hereinafter referred to as ALR1x1/ALE111),
while the maximum number of IOM that can be mounted on a SCS, that is 110, is including the number of ALR1x1/ALE111.
So this tool can not check whether the number of IOM exceeds 110 if ALR1x1/ALE111 are implemented.
For detail of maximum configuration, please refer to "ProSafe-RS Safety Instrumented System Overview (for Vnet/IP)" (GS 32P01B10-01EN).

*12 Input the total word number to be communicated by Safety Subsystem Communication.
Maximum number of CommWord per S2LP131 is 1000 words(a word = two bytes).
ex. When acquiring data( a safety data(8 words) and two non-safety data(2 words each)) from each of 50 GS01 devices,
input 600 (=(8+(2*2) )*50) for the "Number Of Safety Subsystem CommWord".

*13 Applicable target is GS01.

**IO Coprocessor Performance**

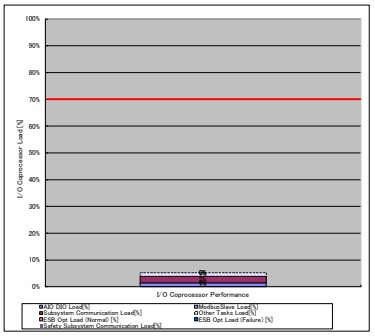
I/O Coprocessor Performance

| | Estimated Performance |
|---|---|
| IO_Cop Idle Time[%] | 95% |
| IO_Cop Idle Time[sec/60sec] | 57 |
| Total Load[%] | 5% |
| Total Execution Time[ms/scan] | 16 |
| AIO DIO Load[%] | 1% |
| AIO DIO Time[ms/scan] | 4 |
| ModbusSlave Load[%] | 0% |
| ModbusSlave Time[ms/scan] | 0 |
| Subsystem Communication Load[%] | 2% |
| Subsystem Communication Time[ms/scan] | 7.48 |
| Safety Subsystem Communication Load[%] | 0% |
| Safety Subsystem Communication Time[ms/sca | 0 |
| Other Tasks Load[%] | 1% |
| Other Tasks ExecutionTime[ms/scan] | 4 |
| ESB Opt Load (Normal) [%] | 0% |
| ESB Opt Load (Normal) [ms/scan] | 0 |
| ESB Opt Load (Failure) [%] | 0% |
| ESB Opt Load (Failure) [ms/scan] | 0 |

**IO_Cop:**
"IO_Cop" is the coprocessor for IO processing on SCP461 and S2CP471. On these CPUs, IO processing was separated from main CPU to improve the performance of IEC logic execution.

**ESB Opt Load (Normal):**
The load about the optical ESB bus commuication when the ESB communication is normal.

**ESB Opt Load (Failure):**
The maximal increased load about the optical ESB bus communication when at least one of the ESB communication bus fails. While both of the ESB communication bus are normal, the ESB Opt Load (Failure) remains 0%




**Limitation on R4.01.00:**
When the CPU load or I/O coprocessor load exceeds 70%, the input processing of SCS is stopped. This causes all the input status to become BAD.
This occurs only when the scan period shorter than 250ms is specified.
This limitation was released with R4.01.01 and R4.02.00.

**This tool is for SCS R4.01.00 or later with S2SC70**

| Item | Input Parameters | | |
|---|---|---|---|
| Common | Scan Period [ms] | 500 | |
| I/O (The sum of I/O groups) | Number of IOM *11 | 23 | (Read Only) The maximum number of IOM is 110. |
| | N-IO (Single) | 0 | (Read Only) |
| | N-IO (Dual-redundant) | 0 | (Read Only) |
| | FIO (Single) | 0 | (Read Only) |
| | FIO (Dual-redundant) | 23 | (Read Only) |
| | Number Of ALR1x1/ALE111 for Subsystem comm. | 0 | (Read Only) |
| | Number Of CommWord | 0 | (Read Only) |
| | Number Of S2LP131 for Safety Subsystem comm. | 0 | (Read Only) |
| | Number Of Safety Subsystem CommWord | 0 | (Read Only) |
| | Number Of Safety Device for Safety Subsystem comm. | 0 | (Read Only) |
| N-IO group1 | Maximum Extention Distance[km] *7 | 0 | Classify the N-IO nodes into three or less groups as to the maximum length of optical cable. Input necessary parameters in each group. In case of no Optical N-ESB Bus Repeaters, input 0 to Maximum Extension Distance. |
| | IOM (Single) *1 | 0 | |
| | IOM (Dual-redundant) *1 | 0 | |
| N-IO group2 | Maximum Extention Distance[km] *7 | 0 | |
| | IOM (Single) *1 | 0 | |
| | IOM (Dual-redundant) *1 | 0 | |
| N-IO group3 | Maximum Extention Distance[km] *7 | 0 | |
| | IOM (Single) *1 | 0 | |
| | IOM (Dual-redundant) *1 | 0 | |
| FIO group 1 | Maximum Extention Distance[km] *7 | 0 | Classify the FIO nodes into three or less groups as to the maximum length of optical cable. Input necessary parameters in each group. In case of no Optical ESB Bus Repeaters, input 0 to Maximum Extension Distance. |
| | N-IO Node Connection (True/False) *10 | FALSE | |
| | IOM (Single) *1 | 0 | |
| | IOM (Dual-redundant) *1 | 23 | |
| | Number Of ALR1x1/ALE111 for Subsystem comm. *5 | 0 | |
| | Number Of CommWord *6 | 0 | |
| | Number Of S2LP131 for Safety Subsystem comm. | 0 | |
| | Number Of Safety Subsystem CommWord *12 | 0 | |
| | Number Of Safety Device for Safety Subsystem comm. *13 | 0 | |
| FIO group 2 | Maximum Extention Distance[km] *7 | 0 | |
| | N-IO Node Connection (True/False) *10 | FALSE | |
| | IOM (Single) *1 | 0 | |
| | IOM (Dual-redundant) *1 | 0 | |
| | Number Of ALR1x1/ALE111 for Subsystem comm. *5 | 0 | |
| | Number Of CommWord *6 | 0 | |
| | Number Of S2LP131 for Safety Subsystem comm. | 0 | |
| | Number Of Safety Subsystem CommWord *12 | 0 | |
| | Number Of Safety Device for Safety Subsystem comm. *13 | 0 | |
| FIO group 3 | Maximum Extention Distance[km] *7 | 0 | |
| | N-IO Node Connection (True/False) *10 | FALSE | |
| | IOM (Single) *1 | 0 | |
| | IOM (Dual-redundant) *1 | 0 | |
| | Number Of ALR1x1/ALE111 for Subsystem comm. *5 | 0 | |
| | Number Of CommWord *6 | 0 | |
| | Number Of S2LP131 for Safety Subsystem comm. | 0 | |
| | Number Of Safety Subsystem CommWord *12 | 0 | |
| | Number Of Safety Device for Safety Subsystem comm. *13 | 0 | |
| IEC Logic *2 | POU Large | 11 | (According to the input POU numbers, the total IO channels processed by all POUs are presumed at least 230 ch, at max 405ch.) |
| | POU Middle | 24 | |
| | POU Small | 8 | |
| | Locking of Internal Variables (True/False) *9 | TRUE | |
| CENTUM Integration | External Scan Period [sec] | 1 | |
| | Mapping Blocks | 0 | |
| | Mapping Elements | 0 | |
| Modbus Slave | Number of Connection *4 | 0 | |
| SCS Safety Communication | Number of Station | 1 | |
| SCS Link Transmission | Number of Data for each station *3 | 13 | |
| | Number of Station for receiving data *8 | 0 | |

*1 Input the number of the single IOMs and the number of the pair of dual-redundant IOMs respectively.
ex. If two DI modules are used dual-redundantly, enter 1 into the IOM (Dual-redundant) cell.

*2 Input number of Programs which classified it's complexity.
See below complexity guide. See also the "Example of complexity of a POU" sheet.

| | Description | Channels | Size |
|---|---|---|---|
| Large | VOTER, SYS_*,... Rich | 10+ | 2+ KB |
| Middle | AI/DI mixed, Ordinary Logic | 4 to 8 | 1 to 2KB |
| Small | DI Rich, Simple Logic | 1 to 6 | 1- KB |

1 POU is estimated to have the following resources approximately.
9 ch/POU (In case of 12ch/IOM)
0 Mapping block/POU

*3 Input average number of data for each connection.
ex. If SCS0101 communicates SCS0102 with 50 send data and 50 receive data,
then input "50" for this parameter. In this case, input "1" for the "Number of Station".

*4 Input number of Modbus Slave connection (sum of ALR1x1 ports and ALE111 connections)
whose access period is faster than 100ms.
(If the access period of a Modbus Slave connection is longer than 100ms,
the load of the Modbus Slave connection is negligible.)

*5 Input the number of ALR1x1/ALE111 for SubSystem Communication.
ex. If one ALR1x1 for two PLCs is implemented for SubSystem connection,
input "1" for the "Number Of ALR1x1".
If two ALR1x1s for redundant configuration are implemented for SubSystem connection,
input "2" for the "Number Of ALR1x1".

*6 Input the total word number to be communicated by SubSystem Communication.
(A word is two bytes.)
ex. If the SCS reads 50 words data from PLC1, and writes 50 words data to PLC1,
and reads 50 words data from PLC2, input 150 for the "Number Of CommWord".

*7 Input the following data.
No Optical ESB Bus Repeaters : 0
Using Optical ESB Bus Repeaters :
Maximum length (km) of optical cable from the CPU node to the farthest I/O node. The length is up to 50km.

For better accuracy, input the calculated distance according to the following formula.
$\Sigma i\ Yi*Xi/Z$
i= from 1 to number of the I/O nodes extended by the Optical N-ESB/ESB Bus Repeaters
Xi = number of the IOMs mounted in the I/O node i
Yi = length of optical cable from the CPU node to the I/O node i (km)
Z= Total number of the IOMs in the group

*8 ex. If the SCS receives the link transmission data from 3 station, input 3 into the parameter.
Number of Station includes SCS and FCS.
If the SCS receives the link transmission data from 2 SCS and 3 FCS, input 5 into the parameter.

*9 Set "True" when "Locking of Internal Variables" on SCS Constants Builder is set to "Enable".
If you set "Enable" to "Locking of Internal Variable", the Execution Time of SCS increases.
Please refer to "Engineering Guide Vol. 1" (IM 32P01C10-01EN) in detail.

*10 Set "True" if N-IO node is connected to the path from the CPU node to the FIO node.
If you set "True" to "N-IO Node Connection", the load about the optical ESB bus commuication increases.

*11 Note that "Number of IOM" is the sum of the following:
"N-IO (Single)", "N-IO (Dual-redundant)", "FIO (Single)" and "FIO (Dual-redundant)".
This is not including the number of ALR1x1/ALE111 for Subsystem communication or Modbus slave communication (hereinafter referred to as ALR1x1/ALE111),
while the maximum number of IOM that can be mounted on a SCS, that is 110, is including the number of ALR1x1/ALE111.
So this tool can not check whether the number of IOM exceeds 110 if ALR1x1/ALE111 are implemented.
For detail of maximum configuration, please refer to "ProSafe-RS Safety Instrumented System Overview (for Vnet/IP)" (GS 32P01R10-01EN).

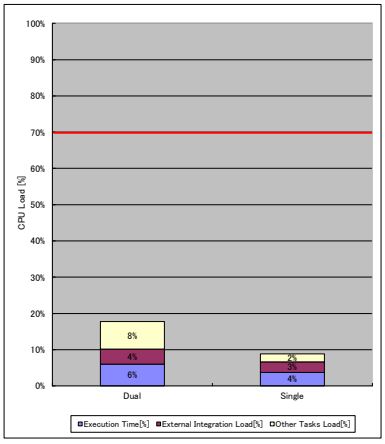
*12 Input the total word number to be communicated by Safety Subsystem Communication.
Maximum number of CommWord per S2LP131 is 1000 words(a word = two bytes).
ex. When acquiring data( a safety data(8 words) and two non-safety data(2 words each)) from each of 50 GS01 devices,
input 600 (=(8+(2*2))*50) for the "Number Of Safety Subsystem CommWord".

*13 Applicable target is GS01.

**Main CPU Performance**

Main CPU Performance

| | Estimated Performance | |
|---|---|---|
| | Dual | Single |
| CPU Idle Time[%] | 82% | 91% |
| CPU Idle Time[sec/60sec] | 49 | 55 |
| Total Load[%] | 18% | 9% |
| Total Execution Time[ms/scan] | 89 | 44 |
| Execution Time[%] | 6% | 4% |
| Execution Time[ms/scan] | 30 | 19 |
| External Integration Load[%] | 4% | 3% |
| External Integration Exec Time[ms/scan] | 21 | 15 |
| Other Tasks Load[%] | 8% | 2% |
| Other Tasks Exec Time[ms/scan] | 38 | 11 |




**Limitation on R4.01.00:**
When the CPU load or I/O coprocessor load exceeds 70%, the input processing of SCS is stopped. This causes all the input status to become BAD.
This occurs only when the scan period shorter than 250ms is specified.
This limitation was released with R4.01.01 and R4.02.00.

**IO Coprocessor Performance**

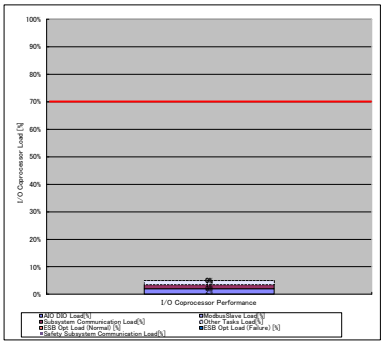
I/O Coprocessor Performance

| | Estimated Performance |
|---|---|
| IO_Cop Idle Time[%] | 95% |
| IO_Cop Idle Time[sec/60sec] | 57 |
| Total Load[%] | 5% |
| Total Execution Time[ms/scan] | 25 |
| AIO DIO Load[%] | 2% |
| AIO DIO Time[ms/scan] | 10 |
| ModbusSlave Load[%] | 0% |
| ModbusSlave Time[ms/scan] | 0 |
| Subsystem Communication Load[%] | 1% |
| Subsystem Communication Time[ms/scan] | 7.48 |
| Safety Subsystem Communication Load[%] | 0% |
| Safety Subsystem Communication Time[ms/sc | 0 |
| Other Tasks Load[%] | 1% |
| Other Tasks ExecutionTime[ms/scan] | 7 |
| ESB Opt Load (Normal) [%] | 0% |
| ESB Opt Load (Normal) [ms/scan] | 0 |
| ESB Opt Load (Failure) [%] | 0% |
| ESB Opt Load (Failure) [ms/scan] | 0 |

**IO_Cop:**
"IO_Cop" is the coprocessor for IO processing on SCP461 and S2CP471. On these CPUs, IO processing was separated from main CPU to improve the performance of IEC logic execution.

**ESB Opt Load (Normal):**
The load about the optical ESB bus commuication when the ESB communication is normal.

**ESB Opt Load (Failure):**
The maximal increased load about the optical ESB bus communication when at least one of the ESB communicaiton bus fails. While both of the ESB communication bus are normal, the ESB Opt Load (Failure) remains 0%




**Limitation on R4.01.00:**
When the CPU load or I/O coprocessor load exceeds 70%, the input processing of SCS is stopped. This causes all the input status to become BAD.
This occurs only when the scan period shorter than 250ms is specified.
This limitation was released with R4.01.01 and R4.02.00.