CROSSWIND

TECHNICAL QUERY
Hollandse Kust Noord

No. TQ :	CW-BALL-TQ-0008	Rev:	B

Originating Party	Crosswind					
Subject	FUEL CELL					
Author	Dominik Sznajder	TQ Aconex unique number: CWHKN-INN-BPH-TQ-00035				
Interface TQ - from	Rosetti	TQ interface source Aconex unique number: ROSMA-INN-BPH-TQ-00065				
Type	Query		X	Interface		
	Deviation			Derogation (SHALL[PS])		
	Note: No deviations nor derogations which have an adverse effect on HSSE will be granted					
Workpackage						
Area(s) of application	Design & Eng.	x	Procurement		Construction	
	Commissioning		Operations		Other	
Issue date	13-11-2023		Urgent reply 5 days		Routine reply 10 days	x
Close-out date	26.06.2025					
Closed-out by	Dominik Sznajder		TQ status:		Closed-out	

1. Description

Reference documents / Aconex unique numbers:

For EMCS functionalities, it is required to monitor and control FUELCELL.

1. Minimum exchange signals to be monitor/control over MODBUS TCP.

The signals listed below as minimum requirements. CPI vendor to advise if any other signals that is critical for operation to be monitored in EMCS.

Signal description	Signal address	Modbus signal (vendor to fill)
LV CB closed status	DI	
LV CB open status	DI	
Total capacity of fuel cell (kW)	AI	
Export mode command	DO	
FuelCell Stop command	DO	
Export setpoint (kW)	AO	
P_optimization for exporting (kW)	AI	
Stack mode: Error, Standby, Running, Off, Initialization, wakup,...	DWORD	
Number of stack online	DWORD	

Crosswind is kindly required to further investigate and formal reply.

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2. Response

Reference documents / Aconex unique numbers :
BLPH FC Package Modbus Table - rev1.xlsx / BPSE-INN-BPH-OTH-00012

Please refer to above-mentioned file.

3. Response

Reference documents / Aconex unique numbers :

After the discussion done in the interface meeting held on 7th May 2024, Fuel Cell vendor BALLARD is kindly required to return feedback on the following topics.

<BALLARD RESPONSE INSERTED IN BLUE>

1. READ SIGNALS NEEDED FOR THE CONTROL BY EMCS:
   A. SIGNALS AT SYSTEM LEVEL:
      1. Active Power produced – the active power produced by the system; this shall be the gross production, before the consumption of auxiliaries
         - Confirm – See "FCWave ## Power Internal"
      2. Auxiliaries Consumption – the active power consumption by electrical auxiliaries
         - Confirm – See "Aux AC Power"
      3. Active Power Exported – the active power exported by the system (supposed equal to gross production minus aux consumption)
         - Confirm – See "Export AC Power"
      4. Status – the current status of the system according to its the state-machine (signal supposed to match the tag "StateMain" in the provided signal list)
         - Confirm – See "StateMain"
      5. Error Code – a code identifying a specific condition that prevents the machine from operating as expected according to its state-machine and current potential
         - Confirm – See "Error Code 1 to 20"
      6. Pending Status – the next status that the machine is going to get into under the current conditions and set point (if under the current condition no transition is foreseen, then the pending status is equal to the current status)
         - May be possible – Not currently implemented

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7. Max Possible Active Power – the maximum active power that the machine can deliver (export) given the current internal and external conditions, under no set-point limitation (signal supposed to match the tag "P_MAX" in the in the provided signal list)
    - Confirm – See "P_MAX"
8. Optimal Active Power Set-Point – the set point that in steady state would reach the maximum energy conversion efficiency, given the current external and internal conditions
    - Confirm – See "P_OPTIMIZED"
9. Hydrogen Consumption – the rate of consumption of hydrogen
    - NOT Confirm – We have no hydrogen flow measurement. An estimate can be provided. Which accuracy is requested?
10. Active Power Set-Point – the set point received Status – the current status of the system according to its the state-machine (signal supposed to match the tag "POWER_SP" in the provided signal list)
    - Confirm – See "P_SETPOINT"
11. Local/Remote control – a digital signal that is true if the system is set to accept the external set-points, as the ones from the EMCS
    - Confirm – See "CONTOL_LOC"
12. Aux Power Supply is Present – a digital signal that is true if the power line that feeds the auxiliaries, before any UPS, is energized
    - Confirm – See "AUX_OK"
13. Counter(s) - Any delay countdown, events counter or measure gap that allow to foresee when a transition will be performed (or if the transition is expected immediately), particularly for the transition from warm up to production condition; i.e. an informative complement to make the current status of the machine explicit; this can be a countdown timer for a deterministically delayed transition, or a temperature distance (e.g. if a warm up status is terminated when reaching a certain temperature), or even a calculated index.

B. SIGNALS FOR EACH FUEL CELL MODULE:

1. Active Power produced
2. Max Possible Active Power
3. Active Power Set-Point
4. Status (maybe already present in the current signal list with the TAG name "FCn_STATE")
5. Error Code
6. Pending Status
7. Counter(s) - Any delay countdown, event counter or measure gap that allows to foresee when a transition will be performed (or if the transition is expected immediately), particularly for the transition from warm up to production condition. I.e. an informative complement to make the status explicit. This can be a countdown timer for a deterministically delayed transition, or a ventilation valve position (e.g. if transition occurs just after a slow-moving valve reaches a certain position), or even a calculated index.

- See section "EXTERNAL INFORMATION" in modbus map

The instantaneous reading of the above signals shall allow, at any moment, to forecast the expected future transitions of the system under the current external conditions and define/estimate the timing of such future transitions. Such prediction shall be possible based on the documentation on the system behavior (updated "C08" document and error codes list).

Considerations:

- Error Code - possibly the Error Code shall expose its classification/priority, so to avoid the need of using look-up tables based on documentation
- Error Codes will be sorted in the Ballard serverity levels as below:
    - Severity 1 – Warning. Package continues operating, but some parameter is at edge of normal operation
    - Severity 2 – Controlled Shutdown. Parameter is outside normal operating range. Controlled shutdown.
    - Severity 3 – Immediate Shutdown. Package performs immediate shutdown.

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IN ADDITION TO THE ABOVE, to enable the CROSSWIND BLPH supervision at higher level, the system shall expose on the same data interface also all the signals that are shown in the machine HMI or that are anyway required to describe the status of the system.

2. INFORMATION THAT IS EXPECTED COVERED IN THE DOCUMENTATION

Description of the system structure, in the limit of what is relevant for production, consumption and ability to follow commands.

Description of the state-machine and transitions of FC system and FC modules, including the conditions for each transition and any side effects of each transition.

Refer to C08 and Fuel Cell Module Intergration Manual

It shall be clearly described in which statuses the system can follow the setpoint and the presence of any limitation or slowdown in doing that.

Description of Error Codes and expected effect of operativity (i.e. how this impacts the expected transitions or the operations within a state).

Command policy, inter alia confirming or detailing:

- No slope – provide the full step of a set point change all at once, so to allow the FC controller to optimally operate the modules
- Avoid to provide set point faster than every 60 seconds.

Heartbit and no-heartbit fallback operation policy – in case the FC does not receive the heartbit signal, we expect the FC to gracefully stop and reduce its consumption at the minimum.

General description of the reaction dynamics.

FC modules embedded utilization policy for each level of active power set point. This information shall allow to identify the ranges of active power set point where a change is not causing any transition and, conversely, the levels of active power set-points that, when passed, are expected to produce a transition in a module (specifically the warm up of new modules).

Energy and hydrogen consumptions in every status, especially during warm up and normal production.

Hydrogen measurements NOT possible. No flowmeasurement is present. This has not been discussed or mentioned previously. An estimate is possible. What accuracy is desired/required?

Energy measurements present and in modbus table.

3. TIME SYNCHRONIZATION

Confirmation regarding time synchronization protocol NTP is still required.

Confirm that this is possible from FC package. We expect details for NTP protocol server from automation vendor or RM.

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4. Response

Reference documents / Aconex unique numbers :
BPSE-INN-BPH-REG-00006

Responses are shown directly in response 3. above (in blue color). Please refer to the Modbus Table (document BPSE-INN-BPH-REG-00006).

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