ATTACHMENT #6

INTERFACE DESIGN REQUIREMENTS

FOR

QSPDS/SAS DATA COMMUNICATIONS (5)

FOR

FLORIDA POWER AND LIGHT CO.

ST. LUCIE PLANT UNIT NO. 1

REQUIREMENT NUMBER 11181-ICE-3111, REVISION 00

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1.0 PURPOSE

This document provides the criteria governing the digital interfaces between the Qualified Safety Parameter Display System (QSPDS) and the Safety Assessment System (SAS) for Florida Power and Light Company's Saint Lucie Unit No. 1.

The interface design requirements presented herein are intended to define both the functional and operational requirements for data communications between QSPDS and SAS. Hardware and software requirements are established to complete the specification and design of the interface.

2.0 SCOPE

The QSPDS/SAS interface shall consist of full duplex digital data links between the two QSPDS processors and the SAS processor.

3.0 APPLICABLE REFERENCES

The latest revision of the listed reference engineering documents should be consulted, except as noted. Project specific documentation shall have precedence.

3.1 ENGINEERING DOCUMENTS

No documents are referenced by this document.

3.2 CODES

No codes are referenced by this document.

3.3 STANDARDS

3.3.1 EIA Standard RS-232-C, "Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange", August, 1969.

4.0 FUNCTIONAL DESIGN REQUIREMENTS

4.1 INFORMATION TRANSFER REQUIREMENTS

The digital interfaces between the QSPDS processors and the SAS processor shall be responsible for transferring the following types of information.

4.1.1 QSPDS to SAS

QSPDS shall be responsible for communicating alarm reports, data block representative of the digitized input signals, respective alarm status byte for each input, and computed Inadequate Core Cooling (ICC) parameters such as subcooled margins and Reactor Vessel Level.

Alarm reports shall include notification of:

- o New Alarms,
- o Returns from Alarm.

4.2 DATA TRANSFER RATE

The QSPDS/SAS data links shall transfer serial information asynchronously at the rate of 19.2K baud with a ten-bit format as shown below.

START BIT	LSB							ODD PARITY BIT	STOP BIT
	1	2	3	4	5	6	7	8	

SERIAL DATA FLOW

This format will allow approximately 1920 eight-bit data bytes to be transferred per second (assuming instantaneous SAS response).

4.3 ELECTRICAL DESIGN REQUIREMENTS

The QSPDS/SAS link is a fiber optic type with two modems. One modem shall be located in the QSPDS cabinet and the other modem in the SAS cabinet. Communication between QSPDS and SAS is provided by the fiber optic link. The fiber optic link shall withstand more than 600 volts DC common mode or 480 VAC at 60 HZ between the inputs and outputs. Each modem has its own internal power supply. The AC Power to the modems must be provided on the QSPDS side and the SAS side. The interface cables between the QSPDS and the fiber optic modem, and the SAS and the fiber optic modem shall carry the communication and data signals shown below.

FIGURE 1

AMS DATA LINK INTERCONNECTION

DTE	DCE			DCE	DTE
	Pin #	Function		Function	Pin #	
AA	1	GND		GND	1	AA
BA	2	TXD		TXD	2	BA
BB	3	RXD		RXD	3	BB
CA	4	RTS		RTS	4	CA
CB	5	CTS		CTS	5	CB
CC	6	DSR	Fiber Optic	DSR	6	CC
AB	7	SIG GND	Cable	SIG GND	7	AB
CD	8	DTR		DTR	8	CD
CF	20	Carrier Detect		Carrier Detect	20	CF
QSPDS Serial Line Adapter	Fiber Optic Modem			Fiber Optic Modem	SAS Communication Multiplexor	

QSPDS Cabinet

The RXD to TXD, CTS to RTS and DSR to DTR interchanges are done by the modems. Therefore from computer to modem no interchange is required, and there is a one-to-one connection as shown above. The above configuration diagram assumes that the QSPDS and SAS computers are configured as Data Terminal Equipment (DTE).

Designation	Definition
AA	Overall Shield (Protective Ground)
AB	Signal Ground
BA	Transmit Data (TXD)
BB	Receive Data (RXD)
CA	Request to Send (RTS)
CB	Clear to Send (CTS)
CC	Data Set Ready (DSR)
CD	Data Terminal Ready (DTR)
CF	Carrier On

The interconnection of these signals is shown in Figure 1. Signal characteristics are defined by the EIA Standard RS-232-C (Reference 3.3.1).

5.0 OPERATIONAL REQUIREMENTS

5.1 INTERFACE CONTROL

5.1.1 Addressing

There shall be two consecutive device addresses for each of the QSPDS/SAS data links; one for receive and one for transmit. Each address shall have separate interrupt control logic associated with it.

5.1.2 Interface Commands

The internal QSPDS data link interface cards shall accept and implement as a minimum the following processor commands:

a. Separate Interrupt Enable/Disable/Disarm Commands for both Transmit and Receive,

b. Data Terminal Ready (CD),

c. Request to Send (CA).

A preferred command byte format for QSPDS is as follows.

Bit 1 (LSB)	TEN	Transmit Enable; 1 = Enable 0 = Disable
Bit 2	DTR	Data Terminal Ready
Bit 3	REN	Receive Enable; 1 = Enable 0 = Disable
Bit 4	Don't Care	
Bit 5	ER	Error Reset; 1 = Reset error flags
Bit 6	RTS	Request to Send
Bit 7	Don't Care	
Bit 8 (MSB)	Don't Care	

5.1.3 Communications Status Byte

The external QSPDS/SAS data link interface cards, when interrogated for status, shall provide as a minimum the following communication status indications:

a. RX Ready,
b. Data Set Ready (CC),
c. TX Ready,
d. Parity Error,
e. Framing Error,
f. Overrun Error,
g. Transmitter Empty.

A preferred communications status byte format for QSPDS is as follows.

Bit 1 (LSB)	Transmitter Ready (TX RDY)
Bit 2	Receiver Ready (RX RDY)
Bit 3	Transmitter Empty (TXE)
Bit 4	Parity Error (PE)
Bit 5	Overrun Error (OE)
Bit 6	Framing Error (FE)
Bit 7	Don't Care
Bit 8 (MSB)	Data Set Ready (DSR)

5.2 COMMUNICATION PROTOCOL

All signal value messages will be acknowledged by SAS with no acknowledge (NAK if an error was detected) or an acknowledge (ACK).

5.2.1 Message Formats

Message packets are transmitted by QSPDS over the fiber optic data link in the form of message blocks. Each message packet has the following format:

BYTES 1 - 2	3	4 through 11	12
MSGNO	ALARM STATUS	SIGNAL VALUE (1 to 8 ASCII CHARS)	GS

MSGNO

The message number is a 2 ASCII character number (00 through 84) and is used to label each message packet transmitted by the QSPDS. The MSGNO starts at zero for the beginning of transmission of an entire message block. If the QSPDS does not receive an acknowledgement ("ACK") from the SAS for a given message packet transmitted, then the message packet is retransmitted with the same, last MSGNO. For example: if the SAS sends an 'ACK', but it gets garbled in the modem and the QSPDS receives a 'd', then the QSPDS will retransmit the last message packet with the last MSGNO, although the SAS will be expecting the next message packet. This is similar to the QSPDS receiving a 'NAK'. The SAS is expected to be able to handle this possible case. Otherwise, the QSPDS will sequence through the message packets, starting at 0 and incrementing by 1 (using the cross-reference table). The MSGNO is used to correlate the data transmitted with its description and to ensure no message packets are lost.

ALARM STATUS

The QSPDS processor sets the alarm status byte when an analog input or digital input point changes alarm status. An alarm status is also changed if there is a break in communication between the QSPDS and its plasma display. The possible alarms are listed below. Bit 7 is always set to one so as not to confuse this byte with the control bytes (STX, EOT, etc.). Bit 8 of the alarm status byte is the odd parity bit.

1. HI (High Limit Alarm)
2. LO (Low Limit Alarm)
3. FAIL (Sensor/equipment Failed)
4. BAD (Bad Data)
5. SUSPCT (Suspect Data)
6. QSPTRB (QSPDS trouble)

PREFERRED ALARM STATUS BYTE

CONFIGURATION

LSB	1 - HI	(High Limit Alarm)
	2 - LO	(Low Limit Alarm)
	3 - FAIL	(Failed Sensor)
	4 - BAD	(Bad Data - Out of Range)
	5 - SUSPCT	(Suspect Data)
	6 - QSPTRB	(QSPDS trouble)
	7 - SET TO 1	(To Avoid Confusion with GS)
MSB	8 - PARITY	(Odd Parity)

Explanations:

Failed Sensor -	Equipment associated with the sensor has failed.
Bad Data -	Sensor input is outside the valid range for the sensor.
Suspect Data -	Calculated results which were affected/revised due to bad data or failed sensor being present.

The convention "1" = alarm/failed condition and "Ø" = normal/operational condition will be employed.

SIGNAL VALUE

Signal value can be any number represented by 1 to 8 ASCII characters.

Ex: 2000.2 is represented by 6 ASCII characters including the decimal point.

GROUP SEPARATOR

Group Separator (GS) is sent to the SAS to indicate the end of message packet. An acknowledge (ACK) or no acknowledge (NAK) ASCII character is sent to QSPDS by the SAS after every message packet. If an ACK is not received by the QSPDS, the message packet is retransmitted up to a maximum of two (2) times before declaring and tagging the data link as failed. The QSPDS will consider parity, framing, and overrun errors as NAKs in that the last data link transmission will be repeated following the above protocol.

5.2.2 Message Block Format

Message block consists of the message packets. Approximately every 1 to 2 seconds, QSPDS transmits the entire Message Block to the SAS. The Message Block has the following format.

STX	Message Packet	.....	Message Packet $_N$	ETX	CHK	EOT

The Message Block starts with start of text (STX) character, followed by message packets and ending with End of Text character (ETX), checksum (CHK, which is an exclusive or of all the data bytes between ETX and STX excluding the control characters GS) and End of Transmission (EOT) character.

6.0 DIAGNOSTIC TEST REQUIREMENTS

The QSPDS/SAS data link diagnostic checks shall be responsible for detecting serious failure of the data link hardware. This shall be accomplished by checking the status of the data link hardware and checking the number of NAKs (or incorrect responses) received consecutively from the SAS. If more than 3 NAKs (or incorrect responses) are received consecutively the data link between QSPDS and SAS is tagged as failed and the error condition is alarmed on the plasma display unit. When a failed data link is detected the transmission is stopped by the QSPDS for the present scan cycle. The transmission of data from the QSPDS to the SAS is restarted the next scan cycle. If a NAK/ACK is not received within 3 seconds after a message packet is sent, the data link is tagged as failed and alarmed on the plasma display unit. The QSPDS tries to establish communication again with SAS the next scan cycle. The QSPDS continuously searches for the operation of the data link every 3 seconds until the link becomes operational. The QSPDS will consider parity, framing, and overrun errors as NAKs in that the last data link transmission will be repeated following the above protocol.

CROSS REFERENCE TABLE
CHANNEL A

MESSAGE NUMBER(2)	POINT ID	DESCRIPTION	VALUE (GIVEN IN RANGE)	UNITS
00	THOT1A	Hot Leg Temp Loop 1A	212-705	°F
01	THOT2A	Hot leg Temp Loop 1B	212-705	°F
02	TCOLD1A	Cold Leg Temp Loop 1A2	212-705	°F
03	TCOLD2A	Cold Leg Temp Loop 1B1	212-705	°F
04	PRESSA	Pressurizer Pressure	0-3000	PSIA
05	DUMMY1A	Dummy Value	0(4)	
06	DUMMY2A	Dummy Value	0(4)	
07	THEADA	Upper Head Temp	32-2300	°F
08	TRCETA	Representative Core Exit Temp	32-2300	°F
09	TMARHEADA	Upper Head Temperature Saturation Margin	-2100 to 700(1)	°F
10	PMARHEADA	Upper Head Pressure Saturation Margin	-3000 to 3000(1)	PSI
11	TMARRCSA	RCS Temperature Saturation Margin	-2100 to 700(1)	°F
12	PMARRCSA	RCS Pressure Saturation Margin	-3000 to 3000(1)	PSI
13	TMARCETA	Core Exit Temperature (CET) Saturation Margin	-2100 to 700(1)	°F
14	PMARCETA	Core Exit Pressure Saturation Margin	-3000 to 3000(1)	PSI
15	TMARURA	RCS/Upper Head Temp Saturation Margin	-2100 to 700(1)	°F
16	RLEVA	Reactor Vessel Level	0 to 100	%
17	DUMMY3A	Dummy Value	0(4)	
18	DUMMY4A	Dummy Value	0(4)	

CROSS REFERENCE TABLE
CHANNEL A (Continued)

MESSAGE NUMBER	POINT ID	DESCRIPTION	VALUE (GIVEN IN RANGE)	UNITS
19	TU1A	Unheated HJTC Temperature Level 1	32 to 2300	°F
20	TU2A	Unheated HJTC Temperature Level 2	32 to 2300	°F
21	TU3A	Unheated HJTC Temperature Level 3	32 to 2300	°F
22	TU4A	Unheated HJTC Temperature Level 4	32 to 2300	°F
23	TU5A	Unheated HJTC Temperature Level 5	32 to 2300	°F
24	TU6A	Unheated HJTC Temperature Level 6	32 to 2300	°F
25	TU7A	Unheated HJTC Temperature Level 7	32 to 2300	°F
26	TU8A	Unheated HJTC Temperature Level 8	32 to 2300	°F
27	TH1A	Heated HJTC Temperature Level 1	32 to 2300	°F
28	TH2A	Heated HJTC Temperature Level 2	32 to 2300	°F
29	TH3A	Heated HJTC Temperature Level 3	32 to 2300	°F
30	TH4A	Heated HJTC Temperature Level 4	32 to 2300	°F
31	TH5A	Heated HJTC Temperature Level 5	32 to 2300	°F
32	TH6A	Heated HJTC Temperature Level 6	32 to 2300	°F

CROSS REFERENCE TABLE
CHANNEL A (Continued)

MESSAGE NUMBER	POINT ID	DESCRIPTION	VALUE (GIVEN IN RANGE)	UNITS
33	TH7A	Heated HJTC Temperature Level 7	32 to 2300	°F
34	TH8A	Heated HJTC Temperature Level 8	32 to 2300	°F
35	DT1A	Differential HJTC Temperature Level 1	-2268 to +2268	°F
36	DT2A	Differential HJTC Temperature Level 2	-2268 to +2268	°F
37	DT3A	Differential HJTC Temperature Level 3	-2268 to +2268	°F
38	DT4A	Differential HJTC Temperature Level 4	-2268 to +2268	°F
39	DT5A	Differential HJTC Temperature Level 5	-2268 to +2268	°F
40	DT6A	Differential HJTC Temperature Level 6	-2268 to +2268	°F
41	DT7A	Differential HJTC Temperature Level 7	-2268 to +2268	°F
42	DT8A	Differential HJTC Temperature Level 8	-2268 to +2268	°F
43	PC1A	Heater Power Control Signal 1	0 to 100	%
44	PC2A	Heater Power Control Signal 2	0 to 100	%
45	Q1HIA	CET Highest Temp Quad-1	32 to 2300	°F
46	Q1HIDA	CET Highest Temp ID (Quad-1)	32 to 2300	°F
47	Q1NHIA	CET Next Highest Temperature Quad-1	32 to 2300	°F
48	Q1NIDA	CET Next Highest Temperature ID (Quad-1)	32 to 2300	°F

CROSS REFERENCE TABLE
CHANNEL A (Continued)

MESSAGE NUMBER	POINT ID	DESCRIPTION	VALUE (GIVEN IN RANGE)	UNITS
49	Q2HIA	CET Highest Temp Quad-2	32 to 2300	°F
50	Q2HIDA	CET Highest Temp ID (Quad-2)	32 to 2300	°F
51	Q2NHIA	CET Next Highest Temperature Quad-2	32 to 2300	°F
52	Q2NIDA	CET Next Highest Temperature ID (Quad-2)	32 to 2300	°F
53	Q3HIA	CET Highest Temp Quad-3	32 to 2300	°F
54	Q3HIDA	CET Highest Temp ID (Quad-3)	32 to 2300	°F
55	Q3NHIA	CET Next Highest Temperature Quad-3	32 to 2300	°F
56	Q3NIDA	CET Next Highest Temperature ID (Quad-3)	32 to 2300	°F
57	Q4HIA	CET Highest Temp Quad-4	32 to 2300	°F
58	Q4HIDA	CET Highest Temp ID (Quad-4)	32 to 2300	°F
59	Q4NHIA	CET Next Highest Temperature Quad-4	32 to 2300	°F
60	Q4NIDA	CET Next Highest Temperature ID (Quad-4)	32 to 2300	°F
61	CET1A	Core Exit Temperature E-20	32 to 2300	°F
62	CET2A	Core Exit Temperature G-18	32 to 2300	°F
63	CET3A	Core Exit Temperature L-18	32 to 2300	°F
64	CET4A	Core Exit Temperature J-16	32 to 2300	°F
65	CET5A	Core Exit Temperature L-16	32 to 2300	°F
66	CET6A	Core Exit Temperature F-19	32 to 2300	°F
67	CET7A	Core Exit Temperature B-15	32 to 2300	°F
68	CET8A	Core Exit Temperature C-16	32 to 2300	°F
69	CET9A	Core Exit Temperature F-11	32 to 2300	°F
70	CET10A	Core Exit Temperature C-18	32 to 2300	°F
71	CET11A	Core Exit Temperature A-10	32 to 2300	°F

CROSS REFERENCE TABLE
CHANNEL A (Continued)

MESSAGE NUMBER	POINT ID	DESCRIPTION	VALUE (GIVEN IN RANGE)	UNITS
72	CET12A	Core Exit Temperature C-13	32 to 2300	°F
73	CET13A	Core Exit Temperature R-6	32 to 2300	°F
74	CET14A	Core Exit Temperature S-3	32 to 2300	°F
75	CET15A	Core Exit Temperature T-2	32 to 2300	°F
76	CET16A	Core Exit Temperature R-4	32 to 2300	°F
77	CET17A	Core Exit Temperature W-4	32 to 2300	°F
78	CET18A	Core Exit Temperature X-11	32 to 2300	°F
79	CET19A	Core Exit Temperature V-11	32 to 2300	°F
80	CET20A	Core Exit Temperature X-7	32 to 2300	°F
81	CET21A	Core Exit Temperature W-6	32 to 2300	°F
82	CET22A	Core Exit Temperature T-9	32 to 2300	°F
83	DUMMY5A	Dummy Value	0(4)	
84	(3)	Reactor Vessel Level 1 through 8 Status Message Packet	0/1(3)	Coolant/No Coolant

NOTES TO CROSS REFERENCE TABLE

(1) + sign indicates subcooling.
- sign indicates superheat.

(2) Message Number is a 2 ASCII character number. It varies from 00 through 84.

(3) Reactor Vessel Level 1 through 8 Status Message

Data Byte

Odd Parity Bit							
MSB							LSB
8	7	6	5	4	3	2	1

Byte #1

Bit 1	Reactor Vessel Level 1 (Coolant/No Coolant)
Bit 2	Reactor Vessel Level 2 (Coolant/No Coolant)
Bit 3	Reactor Vessel Level 3 (Coolant/No Coolant)
Bit 4	Reactor Vessel Level 4 (Coolant/No Coolant)
Bit 5	Reactor Vessel Level 5 (Coolant/No Coolant)
Bit 6	Reactor Vessel Level 6 (Coolant/No Coolant)
Bit 7	Set to "1"

NOTES TO CROSS REFERENCE TABLE (Continued)

Byte #2

Bit 1	Reactor Vessel Level 7 (Coolant/No Coolant)
Bit 2	Reactor Vessel Level 8 (Coolant/No Coolant)
Bit 3	Set to "Ø" by QSPDS - should be ignored by SAS computer.
Bit 4	Set to "Ø" by QSPDS - should be ignored by SAS computer.
Bit 5	Set to "Ø" by QSPDS - should be ignored by SAS computer.
Bit 6	Set to "Ø" by QSPDS - should be ignored by SAS computer.
Bit 7	Set to "1"

Ø indicates presence of coolant.

1 indicates absence of coolant or no coolant.

Bit 7 of these data bytes will be set to "1" (as shown) to avoid confusion which may arise by the SAS deciphering this byte as a 'group separator'.

(4) For dummy values, the integer format will be employed. An example is: ßØ. Integer format is detailed in note 5.a.

(5) Format of Analog Values

a) Integer type: The field width is the size of the maximum range of the value plus 1 for a sign. Positive values have a blank in the sign position, negative values have a minus sign in the sign position. The numeric field is leading zero suppressed, replaced by blanks. If the value is zero, the right most position will contain a zero.

Example: If saturation margin, range +700 to -2100°F, is 50°F the transmitted data is ßßß50. If it is -10°F, the transmitted data is -ßß10. If it is zero, the transmitted data is ßßßß0.

; where ß is ASCII space (blank).

NOTES TO CROSS REFERENCE TABLE (Continued)

b) Exponential Format: Above a value of 10 and below a value of 1000, the integer format (described above) will be used. For the other values, the field width is 8 characters as follows:

a.aaa±bb, where a.aaa is the fractional part of the value and ±bb is the exponential part.

(Note: no sign information is transmitted since the data is always positive.)

For example: 1.23% power is transmitted as 0.123 + 01.

CROSS REFERENCE TABLE
CHANNEL B

MESSAGE NUMBER(2)	POINT ID	DESCRIPTION	VALUE (GIVEN IN RANGE)	UNITS
00	THOT1B	Hot Leg Temp Loop 1A	212-705	°F
01	THOT2B	Hot leg Temp Loop 1B	212-705	°F
02	TCOLD1B	Cold Leg Temp Loop 1A1	212-705	°F
03	TCOLD2B	Cold Leg Temp Loop 1B2	212-705	°F
04	PRESSB	Pressurizer Pressure	0-3000	PSIA
05	DUMMY1B	Dummy Value	0(4)	
06	DUMMY2B	Dummy Value	0(4)	
07	THEADB	Upper Head Temp	32-2300	°F
08	TRCETB	Representative Core Exit Temperature	32-2300	°F
09	TMARHEADB	Upper Head Temperature Saturation Margin	-2100 to 700(1)	°F
10	PMARHEADB	Upper Head Pressure Saturation Marginop..	-3000 to 3000(1)	PSI
11	TMARRCSB	RCS Temperature Saturation Margin	-2100 to 700(1)	°F
12	PMARRCSB	RCS Pressure Saturation Margin	-3000 to 3000(1)	PSI
13	TMARCETB	Core Exit Temperature (CET) Saturation Margin	-2100 to 700(1)	°F
14	PMARCETB	Core Exit Pressure Saturation Margin	-3000 to 3000(1)	PSI
15	TMARURB	RCS/Upper Head Temp Saturation Margin	-2100 to 700(1)	°F
16	RLEVA	Reactor Vessel Level	0 to 100	%
17	DUMMY3B	Dummy Value	0(4)	
18	DUMMY4B	Dummy Value	0(4)	
19	TU1B	Unheated HJTC Temperature Level 1	32 to 2300	°F
20	TU2B	Unheated HJTC Temperature Level 2	32 to 2300	°F

CROSS REFERENCE TABLE
CHANNEL B

MESSAGE NUMBER	POINT ID	DESCRIPTION	VALUE (GIVEN IN RANGE)	UNITS
21	TU3B	Unheated HJTC Temperature Level 3	32 to 2300	°F
22	TU4B	Unheated HJTC Temperature Level 4	32 to 2300	°F
23	TU5B	Unheated HJTC Temperature Level 5	32 to 2300	°F
24	TU6B	Unheated HJTC Temperature Level 6	32 to 2300	°F
25	TU7B	Unheated HJTC Temperature Level 7	32 to 2300	°F
26	TU8B	Unheated HJTC Temperature Level 8	32 to 2300	°F
27	TH1B	Heated HJTC Temperature Level 1	32 to 2300	°F
28	TH2B	Heated HJTC Temperature Level 2	32 to 2300	°F
29	TH3B	Heated HJTC Temperature Level 3	32 to 2300	°F
30	TH4B	Heated HJTC Temperature Level 4	32 to 2300	°F
31	TH5B	Heated HJTC Temperature Level 5	32 to 2300	°F
32	TH6B	Heated HJTC Temperature Level 6	32 to 2300	°F
33	TH7B	Heated HJTC Temperature Level 7	32 to 2300	°F
34	TH8B	Heated HJTC Temperature Level 8	32 to 2300	°F

CROSS REFERENCE TABLE
CHANNEL B (Continued)

MESSAGE NUMBER	POINT ID	DESCRIPTION	VALUE (GIVEN IN RANGE)	UNITS
35	DT1B	Differential HJTC Temperature Level 1	-2268 to +2268	°F
36	DT2B	Differential HJTC Temperature Level 2	-2268 to +2268	°F
37	DT3B	Differential HJTC Temperature Level 3	-2268 to +2268	°F
38	DT4B	Differential HJTC Temperature Level 4	-2268 to +2268	°F
39	DT5B	Differential HJTC Temperature Level 5	-2268 to +2268	°F
40	DT6B	Differential HJTC Temperature Level 6	-2268 to +2268	°F
41	DT7B	Differential HJTC Temperature Level 7	-2268 to +2268	°F
42	DT8B	Differential HJTC Temperature Level 8	-2268 to +2268	°F
43	PC1B	Heater Power Control Signal 1	0 to 100	%
44	PC2B	Heater Power Control Signal 2	0 to 100	%
45	Q1HIB	CET Highest Temp Quad-1	32 to 2300	°F
46	Q1HIDB	CET Highest Temp ID (Quad-1)	32 to 2300	°F
47	Q1NHIB	CET Next Highest Temperature Quad-1	32 to 2300	°F
48	Q1NIDB	CET Next Highest Temperature ID (Quad-1)	32 to 2300	°F
49	Q2HIB	CET Highest Temp Quad-2	32 to 2300	°F
50	Q2HIDB	CET Highest Temp ID (Quad-2)	32 to 2300	°F

CROSS REFERENCE TABLE
CHANNEL B (Continued)

MESSAGE NUMBER	POINT ID	DESCRIPTION	VALUE (GIVEN IN RANGE)	UNITS
51	Q2NHIB	CET Next Highest Temperature Quad-2	32 to 2300	°F
52	Q2NIDB	CET Next Highest Temperature ID (Quad-2)	32 to 2300	°F
53	Q3HIB	CET Highest Temp Quad-3	32 to 2300	°F
54	Q3HIDB	CET Highest Temp ID (Quad-3)	32 to 2300	°F
55	Q3NHIB	CET Next Highest Temperature Quad-3	32 to 2300	°F
56	Q3NIDB	CET Next Highest Temperature ID (Quad-3)	32 to 2300	°F
57	Q4HIB	CET Highest Temp Quad-4	32 to 2300	°F
58	Q4HIDB	CET Highest Temp ID (Quad-4)	32 to 2300	°F
59	Q4NHIB	CET Next Highest Temperature Quad-4	32 to 2300	°F
60	Q4NIDA	CET Next Highest Temperature ID (Quad-4)	32 to 2300	°F
61	CET1B	Core Exit Temperature S-11	32 to 2300	°F
62	CET2B	Core Exit Temperature Y-14	32 to 2300	°F
63	CET3B	Core Exit Temperature V-15	32 to 2300	°F
64	CET4B	Core Exit Temperature W-16	32 to 2300	°F
65	CET5B	Core Exit Temperature X-17	32 to 2300	°F
66	CET6B	Core Exit Temperature N-11	32 to 2300	°F
67	CET7B	Core Exit Temperature T-16	32 to 2300	°F
68	CET8B	Core Exit Temperature N-15	32 to 2300	°F
69	CET9B	Core Exit Temperature N-17	32 to 2300	°F
70	CET10B	Core Exit Temperature S-19	32 to 2300	°F
71	CET11B	Core Exit Temperature V-19	32 to 2300	°F
72	CET12B	Core Exit Temperature D-7	32 to 2300	°F
73	CET13B	Core Exit Temperature C-6	32 to 2300	°F

CROSS REFERENCE TABLE
CHANNEL B (Continued)

MESSAGE NUMBER	POINT ID	DESCRIPTION	VALUE (GIVEN IN RANGE)	UNITS
74	CET14B	Core Exit Temperature B-5	32 to 2300	°F
75	CET15B	Core Exit Temperature D-11	32 to 2300	°F
76	CET16B	Core Exit Temperature B-7	32 to 2300	°F
77	CET17B	Core Exit Temperature G-9	32 to 2300	°F
78	CET18B	Core Exit Temperature L-4	32 to 2300	°F
79	CET19B	Core Exit Temperature L-6	32 to 2300	°F
80	CET20B	Core Exit Temperature F-3	32 to 2300	°F
81	CET21B	Core Exit Temperature D-3	32 to 2300	°F
82	CET22B	Core Exit Temperature J-7	32 to 2300	°F
83	CET23B	Core Exit Temperature D-5	32 to 2300	°F
84	(3)	Reactor Vessel Level 1 through 8 Status Message Packet	0/1(3)	Coolant/No Coolant

NOTES TO CROSS REFERENCE TABLE

(1) + sign indicates subcooling.
- sign indicates superheat.

(2) Message Number is a 2 ASCII character number. It varies from 00 through 84.

(3) Reactor Vessel Level 1 through 8 Status Message

Data Byte

Odd Parity Bit							
MSB							LSB
8	7	6	5	4	3	2	1

Byte #1

Bit 1	Reactor Vessel Level 1 (Coolant/No Coolant)
Bit 2	Reactor Vessel Level 2 (Coolant/No Coolant)
Bit 3	Reactor Vessel Level 3 (Coolant/No Coolant)
Bit 4	Reactor Vessel Level 4 (Coolant/No Coolant)
Bit 5	Reactor Vessel Level 5 (Coolant/No Coolant)
Bit 6	Reactor Vessel Level 6 (Coolant/No Coolant)
Bit 7	Set to "1"

NOTES TO CROSS REFERENCE TABLE (Continued)

Byte #2

Bit 1 Reactor Vessel Level 7 (Coolant/No Coolant)
Bit 2 Reactor Vessel Level 8 (Coolant/No Coolant)
Bit 3 Set to "Ø" by QSPDS - should be ignored by SAS computer.
Bit 4 Set to "Ø" by QSPDS - should be ignored by SAS computer.
Bit 5 Set to "Ø" by QSPDS - should be ignored by SAS computer.
Bit 6 Set to "Ø" by QSPDS - should be ignored by SAS computer.
Bit 7 Set to "1"

Ø indicates presence of coolant.
1 indicates absence of coolant or no coolant.

Bit 7 of these data bytes will be set to "1" (as shown) to avoid confusion which may arise by the SAS deciphering this byte as a 'group separator'.

(4) For dummy values, the integer format will be employed. An example is: ßØ. Integer format is detailed in note 5.a.

(5) Format of Analog Values

a) Integer type: The field width is the size of the maximum range of the value plus 1 for a sign. Positive values have a blank in the sign position, negative values have a minus sign in the sign position. The numeric field is leading zero suppressed, replaced by blanks. If the value is zero, the right most position will contain a zero.

Example: If saturation margin, range +700 to -2100°F, is 50°F the transmitted data is ßßß50. If it is -10°F, the transmitted data is -ßß10. If it is zero, the transmitted data is ßßßß0.

; where ß is ASCII space (blank).

NOTES TO CROSS REFERENCE TABLE (Continued)

b) Exponential Format: Above a value of 10 and below a value of 1000, the integer format (described above) will be used. For the other values, the field width is 8 characters as follows:

a.aaa±bb, where a.aaa is the fractional part of the value and ±bb is the exponential part.

(Note: no sign information is transmitted since the data is always positive.)

For example: 1.23% power is transmitted as 0.123 + 01.