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ACCESSION NBR:8408070275 DOC.DATE: 84/08/01 NOTARIZED: NO DOCKET #
FACIL:50-305 Kewaunee Nuclear Power Plant, Wisconsin Public Servic 05000305
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EISENHUT,D.G. Division of Licensing

SUBJECT: Forwards addl info on safety parameter display sys in response to 840326 request & suppl to SAR.Sys scheduled for implementation by end of Spring 1985 refueling outage. Rev 1-A to WCAP-7819 & WCAP-7685A encl.

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NRC-84-123

WISCONSIN PUBLIC SERVICE CORPORATION

P.O. Box 1200, Green Bay, Wisconsin 54305

August 1, 1984

Director, Office of Nuclear Reactor Regulation
Attention: Mr. D. G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Eisenhut:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Additional Information on SPDS

References: 1) Letter from C. W. Giesler to D. G. Eisenhut dated April 15, 1983
2) Letter from C. W. Giesler to D. G. Eisenhut dated Sept. 2, 1983
3) Letter from S. A. Varga to C. W. Giesler dated March 26, 1984
4) Letter from C. W. Giesler to D. G. Eisenhut dated May 25, 1984

In references 1 and 2 we provided you information regarding the Implementation of Integrated Emergency Response Capability and the Safety Analysis Report for the Safety Parameter Display System.

In reference 3 you requested additional information that was necessary for you to continue your review. In reference 4, we proposed a response date of August 1, 1984, for the requested information.

The attachment to this letter provides the additional information on the Safety Parameter Display System you need to continue your review. The response is formatted to address the questions presented in reference 3 and is submitted as a supplement to the original Safety Analysis Report (reference 2). The Safety Parameter Display System is scheduled for implementation by the end of the spring 1985 refueling outage.

A001
1/1

Very truly yours,

Don C. Hintz
Manager - Nuclear Power

KAH/js

Attach.

cc - Mr. S. A. Varga, US NRC
Mr. Robert Nelson, US NRC

NRC Question 1: Basis of Parameter Selection

In Reference 2, the licensee states that parameter selection for the SPDS was based on the generic Westinghouse Owners' Group Emergency Operating Procedures. No other information was provided on the selection of the parameters. This one statement does not define the basis for the selection of the individual parameters used in the Safety Parameter Display System. To conduct the review of this material, the staff requires the licensee to define and document the basis (e.g., comparison to NUREG-0737 Supplement 1, functional requirements, etc.) for each parameter selected (if not already done) and submit same as a supplement to the SAR.

WPSC Response:

Selection of the minimum SPDS parameter set for the Safety Assessment System (SAS) was performed by the Ad Hoc Committee for Instrument Systems which directed the SAS project. This group reviewed the latest generic Emergency Operating Procedures available at the time and made a selection to encompass process variables used by operators in their assessment of off normal plant conditions. This list was compared to other existing lists, namely those developed by NSAC and AIF; where parameter selections differed, the committee evaluated the parameters and, in some instances, included additional variables.

Since the completion of the generic SAS project, the WPS effort has been directed towards providing a Kewaunee specific implementation. As the generic EOP's have undergone substantial revision, the parameter set has not been continuously reviewed. The ultimate justification of the parameter selection will be the validation of the SAS on the Kewaunee specific simulator.

NUREG 0696, Section 5.5, identifies the "important plant functions" which the primary display shall monitor. While these functions encompass the Critical Safety Functions (CSF), the WPS SAS provides monitoring of the functions independent of the formal CSF monitoring program. Each function is addressed below:

NOTE: The initial installation of the Safety Assessment System incorporated only those computer input points which had been provided prior to the computer upgrade which installed the SAS system. Process variables which are not presently connected to the computer, but included in the following discussion have been identified by an asterisk (*). Future WPS action will either connect these points or remove reference to them based upon operational or licensing reviews.

Reactivity Control

One of the critical safety functions associated with maintaining the fuel clad barrier intact is reactivity control, i.e., the control of energy release in the fuel.

For all modes of normal plant operation the primary indication of core reactivity is neutron flux which is monitored and displayed on the SPDS. For normal heatup, cooldown, and power operation, neutron flux information is provided in appropriate units of counts per second, amps, or percent power. The SPDS provides neutron flux information via appropriate use of fission chamber detectors, compensated and uncompensated ion chamber detectors and associated electronics which monitor the entire power range. This range covers the source range (SR) in units of counts per second, intermediate range (IR) in units of amps, and power range (PR) in percent power. For the cold shutdown display, neutron flux information is provided in a trend graph format.

For off-normal or accident conditions, the objective of reactivity control is subcriticality. Decreasing flux level provides the information for assessing whether or not subcriticality is being achieved and maintained.

Reactor Core Cooling and Heat Removal from the Primary System

Adequate core cooling and heat removal from the primary system ensure fuel cladding temperatures remain below failure limits. Coolant inventory, coolant temperature, subcooling, and primary system heat sinks are monitored to assess core cooling.

Primary indicators of core cooling include coolant temperature and level of subcooling. For normal power, heatup, and cooldown operations, core exit, cold leg, and hot leg temperatures are monitored to provide core exit, cold leg, and coolant average temperature indications. Level of subcooling is also indicated in these modes. Reactor vessel level* is monitored and displayed for all normal operating modes. Pressurizer level is monitored for all normal operating displays, except cold shutdown. Both reactor vessel* and pressurizer levels are available in trend graph format. For cold shutdown, core exit temperature is monitored. For off-normal and accident conditions, core exit temperature, level of subcooling, vessel water level*, and reactor coolant pump status[1] are monitored; these variables provide indication of the core thermodynamic state and the degree to which core cooling is accomplished. Level of subcooling, core exit temperature, and cold leg temperatures are also available in trend graph format.

The main heat sink for the primary system consists of two steam generators. If the steam generators are receiving adequate flow, are not overpressurized, and have sufficient inventory, then an adequate heat sink

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[1]Reactor coolant pump status is derived from individual loop flows in excess of 20% normal. This value exceeds flows expected during natural circulation operation and is not subject to errors caused by monitoring breaker positions.

exists. For normal power, heatup, and cooldown operating modes, steam generator level and pressure are monitored and displayed. For off-normal or accident conditions, steam generator level and pressure and auxiliary feedwater flow* are monitored. Steam generator pressure and level are also available in trend graph format. Additionally, steam flow is monitored and displayed in trend graph format in order to provide indication of potential steam/feed flow mismatch which may lead to a reduced capacity of the heat sink.

For cold shutdown, decay heat is removed using the manually initiated residual heat removal (RHR) system. RHR system flow and heat exchanger inlet and outlet temperatures, which indicate the performance of this heat sink, are monitored and trend graph displayed for this mode of operation.

Reactor Coolant System Integrity

In order to assess the reactor coolant system integrity function, the operator must be cognizant of the potential for breach of integrity, the indication that a breach may have occurred, and the status of actions taken to mitigate the potential for breach of integrity.

Parameters for monitoring the potential for breach of the reactor coolant system integrity include reactor coolant system pressure, reactor coolant system temperature, and cold leg temperature. Parameters for monitoring the actual breach of the reactor coolant system include reactor coolant system pressure, reactor vessel* and pressurizer levels, containment radiation, containment pressure*, containment sump level*, steam generator blowdown radiation, and condenser air ejector radiation. All of these parameters are available on trend graph displays.

Reactor coolant pressure is monitored and displayed for all operating modes. Actual cooldown conditions are monitored by the SAS and compared to proper reactor coolant system pressure and temperature combinations.

Detection that a breach has occurred will be indicated by various parameters depending on the location and magnitude of the breach. Decreasing reactor coolant pressure, reactor vessel level*, and pressurizer level will indicate a breach. Increasing containment pressure*, radiation, and sump level* will indicate the coolant is exiting into containment. Increased steam generator blowdown and condensor air ejector radioactivity levels indicate coolant is exiting through steam generator tubes into the secondary side.

Containment Conditions

In order to assess the status of containment integrity, the operators must be cognizant of the potential for breach of integrity and the status of actions taken to mitigate the potential for breach of integrity.

Containment conditions monitored which indicate a possible threat to integrity include containment pressure*, sump level*, and radiation. The primary threat to containment is from overpressurization which could cause a breach of containment. Sump level* is monitored to indicate leakage in containment and the potential for flooding. Radiation, which does not pose a threat to containment integrity directly, is monitored to assess the magnitude of potential consequences of a breach and the need to ensure proper isolation of containment. All these parameters are monitored and displayed on the SPDS. Additionally, containment pressure*, sump level*, and radiation are available in trend graph format.

Radioactivity

In order to assess the status of radioactivity, all major identified release points must be monitored.

A potential radioactive release point during normal, off-normal, and accident conditions is the auxiliary building vent stack. The SAS monitors the stack activity. Containment radiation level is also monitored by the SAS to enable the operators to assess the potential for releases resulting from accidents. Radioactivity that could be released through the steam generators to the secondary side is monitored by the steam generator blowdown and condenser air ejector radiation monitors.

The containment, steam generator blowdown, and condenser air ejector activities are monitored and indicated on the SAS for power, heatup, and cooldown modes of operation, and are also trend graphed. The auxiliary building vent stack is monitored and indicated on the SAS in a trend graph format. All trend graphs for these potential release points are overlayed on the same display.

Parameter Range

The ranges of monitored parameters are tabulated in Appendix 1B. Analog signals which provide input to the SAS are identified with their corresponding ranges. In general, all ranges monitored by the SAS are identical to those in the control room.

Neutron flux information is provided by three ranges: source range from 1 to 10^6 cps, intermediate range from 10^{-11} to 10^{-3} amps, and power range from 0 to 120 percent of reactor power. Full range monitors with SR, IR, and PR outputs are used with sufficient overlap of ranges to provide this information.

Pressurizer level and reactor vessel level* are monitored and displayed from 0 to 100 percent of capacity.

Core exit temperature[2] is monitored and displayed over a range of 140 to 2,300°F. This range adequately envelopes indication of reactor coolant saturation or superheat conditions for design and maximum technical specification pressure limits of the reactor coolant system.

Cold and hot leg temperatures are monitored from 50 to 620°F. Average reactor coolant temperature, which is based on cold and hot let temperatures, is displayed over the same range.

Level of subcooling is a derived parameter based on coolant temperature and pressure and is displayed from 100°F subcooling to 50°F of superheat. Parameter inputs for subcooling include core exit temperature and coolant system pressure both of which have adequate ranges as discussed elsewhere.

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[2]Core exit temperature is limited by the existing instrumentation and not by the SPDS. Following the upgrade of the core exit thermocouple system, the full range of core exit temperature will be provided by the SAS.

Narrow range steam generator level is monitored and displayed from 0 to 100 percent. Steam generator pressure is monitored and displayed from 0 to 1,400 psig. This range extends beyond the steam generator secondary side design pressure of 1,085 psig, and extends beyond the highest safety valve relief setpoint of 1,127 psig.

Normal feedwater flow and auxiliary feedwater flow* are monitored from 0 to 4.00×10^6 lbm/hr and 0 to 500 gpm, respectively. Steam generator steam flow is also monitored and displayed from 0 to 4.00×10^6 lbm/hr. These flow rates are on a per-loop basis. The range of both the normal feedwater and steam flow displays exceed the full load steam generator flow rate of 3.54×10^6 lbm/hr. The auxiliary feedwater flow* rate range is sized for the design capacity per train of the turbine and motor-driven auxiliary feedwater pumps.

RHR system flow is monitored and displayed from 0 to 4,000 gpm which is equal to the total system design flow rate.

RHR heat exchanger inlet and outlet temperatures are monitored from 100 to 400°F which exceeds the RHR system startup temperature of 350°F and meets, at the upper end of the range, the RHR system design temperature of 400°F.

Pressurizer pressure is monitored from 0 to 2,500 psig. This range exceeds the design pressure rating of 2,485 psig for the reactor coolant system.

Containment pressure* is monitored and displayed from -5 to 200 psig and exceeds containment design pressure of 46 psig. This range also exceeds the design basis accident maximum for a double ended pipe break of 42.5 psig.

The range that containment radiation is monitored over is 1 to 1 x 10^4 mR/hr.

Steam generator blowdown radiation and air ejector radiation are monitored and displayed from 10 to 10^6 counts per minute. These ranges are sufficient to detect a primary to secondary system leak.

Auxiliary building vent stack activity is monitored and displayed from 10 to 10^6 counts per minute. This monitor will display levels of radioactive releases which are not being processed through either the containment exhaust or shield building exhaust systems.

APPENDIX 1A

SAS CRITICAL SAFETY FUNCTIONS AND ASSOCIATED MONITORED AND DISPLAYED PARAMETERS

CRITICAL SAFETY FUNCTION	MONITORED PARAMETER	DISPLAYED PARAMETER	TREND GRAPHED
Reactivity Control	(SR, IR & PR Monitor) Power	(SR, IR, & PR Monitor) Power	X
	Reactor Trip Status	Reactor Trip Statua	
Reactor Core Cooling and Heat Removal from the Primary System	Reactor Vessel Level*	Reactor Vessel Level	X
	Pressurizer Level	Pressurizer Level	X
	Core Exit Temperature	Core Exit Temperature	X
	Cold Leg Temperature	Cold Leg Temperature	X
	Hot Leg Temperature and Cold Leg Temperature	Reactor Coolant Average Temp.	X
	Reactor Coolant Loop Flows	Reactor Coolant Pump Status	
	Core Exit Temperature and Reactor Coolant Pressure	Level of Subcooling	X
	Steam Generator Level	Steam Generator Level	X
	Steam Generator Pressure	Steam Generator Pressure	X
	Auxiliary Feedwater Flow*	Auxiliary Feedwater Flow	
	Steam Generator Steam Flow	Steam Generator Steam Flow	X
	RHR System Flow	RHR System Flow	X
	RHR Heat Exchanger Inlet Temp.	RHR Heat Exchanger Inlet Temp.	X
	RHR Heat Exchanger Outlet Temp.	RHR Heat Exchanger Outlet Temp	X
Reactor Coolant System Integrity	Reactor Coolant Loop Pressure and Pressurizer Pressure	Reactor Coolant System Pressure	X
	Cold Leg Temperature and Hot Leg Temperature	Reactor Coolant Average Temperature	X
	Cold Leg Temperature	Cold Leg Temperature	X
	Reactor Vessel Level*	Reactor Vessel Level	X
	Pressurizer Level	Pressurizer Level	X
	Containment Radiation	Containment Radiation	X
	Containment Pressure*	Containment Pressure	X
	Containment Sump Level*	Containment Sump Level	X
	Steam Generator Blowdown Rad.	Steam Generator Blowdown Rad.	X
	Condenser Air Ejector Radiation	Condenser Air Ejector Radiation	X
Containment Conditions	Containment Pressure*	Containment Pressure	X
	Containment Sump Level*	Containment Sump Level	X
	Containment Radiation	Containment Radiation	X
Radioactivity Control	Auxiliary Building Vent Stack Radiation	Auxiliary Building Vent Stack Radiation	X
	Containment Radiation	Containment Radiation	X
	Steam Generator Blowdown Rad.	Steam Generator Blowdown Rad.	X
	Condenser Air Ejector Radiation	Condenser Air Ejector Radiation	X

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APPENDIX 1B

SPDS PARAMETER RANGES

DISPLAYED PARAMETER	DISPLAYED RANGE
Reactor Power (SR, IR, and PR Monitor)	1 to 10^6 cps (SR) 10^{-11} to 10^{-3} Amps (IR) 0 to 120% (PR)
Reactor Vessel Level*	0 to 100%
Pressurizer Level	0 to 100%
Core Exit Tempersture	140 to 2,300°F, trend 100 to 1,000
Cold Leg Temperature	50 to 600°F, narrow range 520 to 620
Hot Leg Temperature	50 to 600°F, narrow range 520 to 620
Level of Subcooling	100°F Subcooled to 50°F Superheat
Steam Generator Level	0 to 100%
Steam Generator Pressure	0 to 1,400 psig
Normal Feedwater Flow	0 to 4.0 x 10^6 lbm/hr
Auxiliary Feedwater Flow*	0 to 500 gpm
Steam Generator Steam Flow	0 to 4.0 x 10^6 lbm/hr
RHR System Flow	0 to 4,000 gpm
RHR Heat Exchanger Inlet and Outlet Temperatures	100 to 400°F
Pressurizer Pressure (Displayed as Reactor Coolant Pressure)	0 to 2,500 psig
Containment Pressure*	-5 to 200 psig
Containment Sump Level*	0 to 22 ft.
Containment Radiation	1 to 10^4 mR/hr
Steam Generator Blowdown Radiation	10 to 10^6 cpm
Condenser Air Ejector Radiation	10 to 10^6 cpm
Auxiliary Building Vent Stack Effluent	10 to 10^6 cpm

NRC Question 2: Data Validation

The staff evaluated the licensee's design for means which are provided to assure that the data displayed are valid. The staff was unable to find any material which describes the data validation process. To conduct this review, the staff requires a description of this process and assurance that the process does work and has been tested. This description should be limited to the parameters displayed by the Safety Parameter Display System. The staff requires the licensee to describe and document the data validation process (if not already done) and supplement the Safety Analysis Report in order that the staff may complete its review. This should include the Critical Safety Function Monitor if this monitor is considered part of the Safety Parameter Display System.

WPS Response:

The SPDS parameters presented to the operator by the SAS displays have been validated by an algorithm developed by the generic SAS project. This algorithm implements a rejection criteria developed by Chauvenet which was coded by Quadrex in the demonstration software. The essence of the algorithm is to eliminate input values exceeding a "probable" deviation from a mean value in a recursive manner until at least two values remain. If the remaining two values are spread excessively the final average is considered questionable and so indicated to the operator by displaying the numeric value in yellow rather than white. This procedure is preceded by a simple hi/low value check. (See Appendix 2B)

Appendix 2A is an excerpt from the Functional Design Specification for SAS Software dated May 20, 1982; this attachment provides an analytioal description of the process.

The supplier of the WPS SAS converted the demonstration software to execute on their computer. As part of the WPS Verification and Validation (V&V) program the algorithm was tested and found to perform unsatisfactorly. It should be noted that equation (14) of Appendix 2A computes a population variance estimate and not a sample variance. Since the data rejection is applied against the entire sample, the (n-1) denominator should be (n). This change was made, tested, and found acceptable.

To provide additional assurance that the performance of the installed system matched that of the design, and that the correction noted above was valid, the demonstration software modules were compiled on the WPS corporate computer and linked to a simple test driver. The output of this test is Appendix 2C; only test cases with equal weights were executed, as the weighting feature is not used in the WPS system. An objective review of this output provides empirical proof that the validation algorithm does work. Similar testing of the actual operating software was performed by manually inserting values into the computer data base and observing the output. Any further deficiencies identified by our V&V program will be resolved prior to implementation of the SPDS.

The source software for the demonstration system and the operating system is available for your inspection on-site if you find it necessary for your review.

The Critical Safety Function Monitor is not considered part of the Safety Parameter Display System.

Appendix 2A

Analytical Description of Data Rejection Process

B. Multiple Measurements of the Same Parameter

1. Theory

Applying data rejection techniques to transient data in order to detect minor instrument errors such as drift, calibration errors, etc. is a difficult task. In the case of many multiple measurements, a statistical interpretation of the multiple inputs can be used to reject bad data. If a mathematical system model were available, sensor changes due to system changes could be compared to the actual readings to detect measurement errors. In the present case, however, a less elaborate scheme has to be used due to a lack of system models within SAS.

A sample $\overline{X}$, and the estimate of the sample variance, σ_x^2 needs to be computed for any parameter containing multiple inputs. If we allow for some measurements to be "worth" more than others (i.e., narrow range versus wide-range), then a general equation for the mean is,

$$\overline{X} = \frac{\sum_{i=1}^{N_o} W_i X_i}{\sum_{i=1}^{N_o} W_i} \qquad (13)$$

where,

N_o = number of redundant measurements

X_i = raw data

W_i = weighting factor for measurement i

and the variance is,

$$\sigma_x^2 = \sum_{i=1}^{N_o} \left[W_i (X_i - \overline{X})^2 \right] \Big/ \left(\sum_{i=1}^{N_o} X_i - 1 \right) \qquad (14)$$

A simple rejection criteria developed by Chauvenet accounts for effects of sample size, N_o, and the deviation of a sample from the mean. Chauvenet's criteria allows a sample to be rejected if the probability is less than $(1/2\ N_o)$ that deviations from the mean equal to or greater than the sample deviation can occur. This probability is computed from integrating the normal distribution from $\pm\ |x-\overline{x}|$. If a sample is rejected, a new mean is recalculated, and the criteria applied again to the remaining good data.

Once the sample data has passed the rejection tests, derived parameters and rates-of-change calculations are performed. These results are then passed to the SAS logic in order to complete the set of calculations for each sample set $\underline{N}$.

Inputs which have been rejected from scan are listed on a display available on the secondary CRT.

2. SAS Implementation

a) Chauvenet's criteria

The probability for Chauvenet's criteria is the integration of the normal distribution from $-|X_i - \overline{X}|$ to $|X_i - \overline{X}|$, i.e.,

$$F(X_i) = \frac{1}{\sigma\sqrt{2\pi}} \int_{-\frac{|X_i - \overline{X}|}{\sigma}}^{\frac{|X_i - \overline{X}|}{\sigma}} e^{-\mu^2/2}\, d\mu \qquad (15)$$

where X_i is the input sensor data, $\overline{X}$ is the mean value of X_i's, σ is the standard deviation calculated from Equation (14), and μ is the integration variable. For N_o sensor input, the Chauvenet's criteria says:

"if $F(X_i) > \frac{1}{2N_o}$, the data will be rejected."

With the data from a statistic table, we can obtain the Chauvenet's criteria for different N_o in the unit of the standard deviation σ. For example, if $N_o = 4$, the Chauvenet's criteria is:

$$\frac{|X_i - \overline{X}|}{\sigma} = 1.534. \tag{16}$$

The Chauvenet's criteria in units of standard deviation are listed in the Table B-3 for $N_o = 1$ to $N_o = 60$.

Chauvenet's Criteria for Different Number of Sensor Inputs from No = 1 to No = 60

TABLE B-3

No	$\frac{\lvert x_i - \bar{x} \rvert}{\sigma}$	No	$\frac{\lvert x_i - \bar{x} \rvert}{\sigma}$	No	$\frac{\lvert x_i - \bar{x} \rvert}{\sigma}$	No	$\frac{\lvert x_i - \bar{x} \rvert}{\sigma}$	No	$\frac{\lvert x_i - \bar{x} \rvert}{\sigma}$
1	0.675	13	2.070	25	2.327	37	2.472	49	2.570
2	1.150	14	2.100	26	2.340	38	2.481	50	2.575
3	1.383	15	2.128	27	2.355	39	2.490	51	2.580
4	1.534	16	2.155	28	2.369	40	2.498	52	2.590
5	1.645	17	2.178	29	2.382	41	2.505	53	2.598
6	1.731	18	2.200	30	2.394	42	2.515	54	2.604
7	1.803	19	2.220	31	2.407	43	2.525	55	2.608
8	1.862	20	2.240	32	2.420	44	2.531	56	2.614
9	1.914	21	2.260	33	2.427	45	2.537	57	2.621
10	1.960	22	2.278	34	2.438	46	2.547	58	2.629
11	2.000	23	2.294	35	2.448	47	2.554	59	2.633
12	2.036	24	2.309	36	2.458	48	2.560	60	2.637

APPENDIX 2B

Summary of the Results After Data Rejection Test for Different Sensor Input

NUMBER OF SENSOR INPUTS	RESULT	CONDITION
1	Sensor out of range.	FAIL
	Sensor in range.	O.K.
2	One sensor out of range	ALERT
	Two sensors out of range	FAIL
	No sensor out range and percent difference > 10%.	ALERT
	No sensor out of range and percent difference ≤ 10%.	O.K.
>3	one sensor left after rejection test.	ALERT
	two sensors left after rejection test and percent difference > 10%.	ALERT
	two sensors left after rejection test and percent difference ≤ 10%.	O.K.
	more than two sensors left after rejection test.	O.K.

Appendix 2C

Output of Data Rejection Test

UNVALIDATED INPUTS =	95.00	97.00	101.00	98.00
VALIDATED INPUTS =	95.00	97.00	101.00	98.00
COMPUTED AVERAGE =	97.75	STATUS VALUE = 0		
UNVALIDATED INPUTS =	95.00	37.00	101.00	98.00
VALIDATED INPUTS =	95.00	101.00	98.00	
COMPUTED AVERAGE =	98.00	STATUS VALUE = 0		
UNVALIDATED INPUTS =	100.00	101.00	99.00	90.00
VALIDATED INPUTS =	100.00	101.00	99.00	
COMPUTED AVERAGE =	100.00	STATUS VALUE = 0		
UNVALIDATED INPUTS =	100.00	101.00	99.00	95.00
VALIDATED INPUTS =	100.00	101.00	99.00	
COMPUTED AVERAGE =	100.00	STATUS VALUE = 0		
UNVALIDATED INPUTS =	100.00	101.00	99.00	96.00
VALIDATED INPUTS =	100.00	101.00	99.00	
COMPUTED AVERAGE =	100.00	STATUS VALUE = 0		
UNVALIDATED INPUTS =	100.00	101.00	99.00	97.00
VALIDATED INPUTS =	100.00	101.00	99.00	97.00
COMPUTED AVERAGE =	99.25	STATUS VALUE = 0		
UNVALIDATED INPUTS =	100.00	99.00	98.00	95.00
VALIDATED INPUTS =	100.00	99.00	98.00	
COMPUTED AVERAGE =	99.00	STATUS VALUE = 0		
UNVALIDATED INPUTS =	100.00	99.00	97.00	96.00
VALIDATED INPUTS =	100.00	99.00	97.00	96.00
COMPUTED AVERAGE =	98.00	STATUS VALUE = 0		
UNVALIDATED INPUTS =	34.00	36.00	37.00	34.00
VALIDATED INPUTS =	34.00	36.00	37.00	34.00
COMPUTED AVERAGE =	35.25	STATUS VALUE = 0		
UNVALIDATED INPUTS =	30.00	34.00	35.00	33.00
VALIDATED INPUTS =	34.00	35.00	33.00	
COMPUTED AVERAGE =	34.00	STATUS VALUE = 0		
UNVALIDATED INPUTS =	30.00	40.00	50.00	60.00
VALIDATED INPUTS =	30.00	40.00	50.00	60.00
COMPUTED AVERAGE =	45.00	STATUS VALUE = 0		
UNVALIDATED INPUTS =	0.00	2.00	99.00	97.00
VALIDATED INPUTS =	0.00	2.00	99.00	97.00
COMPUTED AVERAGE =	49.50	STATUS VALUE = 0		

UNVALIDATED INPUTS =	34.00	37.00	36.00	
VALIDATED INPUTS =	34.00	37.00	36.00	
COMPUTED AVERAGE =	35.67	STATUS VALUE = 0		
UNVALIDATED INPUTS =	33.00	37.00	36.00	
VALIDATED INPUTS =	33.00	37.00	36.00	
COMPUTED AVERAGE =	35.33	STATUS VALUE = 0		
UNVALIDATED INPUTS =	32.00	37.00	36.00	
VALIDATED INPUTS =	37.00	36.00		
COMPUTED AVERAGE =	36.50	STATUS VALUE = 0		
UNVALIDATED INPUTS =	66.00	67.00	62.00	
VALIDATED INPUTS =	66.00	67.00		
COMPUTED AVERAGE =	66.50	STATUS VALUE = 0		
UNVALIDATED INPUTS =	66.00	67.00	63.00	
VALIDATED INPUTS =	66.00	67.00	63.00	
COMPUTED AVERAGE =	65.33	STATUS VALUE = 0		
UNVALIDATED INPUTS =	120.00	23.00	84.00	
VALIDATED INPUTS =	23.00	84.00		
COMPUTED AVERAGE =	53.50	STATUS VALUE = 1		
UNVALIDATED INPUTS =	16.00	24.00		
VALIDATED INPUTS =	16.00	24.00		
COMPUTED AVERAGE =	20.00	STATUS VALUE = 1		
UNVALIDATED INPUTS =	86.00	94.00		
VALIDATED INPUTS =	86.00	94.00		
COMPUTED AVERAGE =	90.00	STATUS VALUE = 0		
UNVALIDATED INPUTS =	10.00	-1.00	20.00	89.30
VALIDATED INPUTS =	10.00	20.00		
COMPUTED AVERAGE =	15.00	STATUS VALUE = 1		

KEY

Unvailidated Inputs	:	Inputs to SPDS
Validated Inputs	:	Inputs that pass data rejection tests
Computed Average	:	Average of validated inputs
Status Value	:	Data status of the output data

0 = Normal
1 = Alert
2 = Abnormal
3 = Failed

NRC Question 3: Isolation Devices

The licensee is to provide the following information to the NRC for confirmatory review:

a. For each type of device used to accomplish electrical isolation at Kewaunee, describe the specific testing performed to demonstrate that the device is acceptable for its application(s). This description should include elementary diagrams where necessary to indicate the test configuration and how the maximum credible faults were applied to the devices.

WPS Response:

The NIS electrical isolation devices used at Kewaunee are Foxboro isolation amplifiers. The Foxboro models used at Kewaunee were tested by Westinghouse as reported in Westinghouse reports WCAP-7506-L (Proprietary), WCAP-7819, Revision 1 (Nonproprietary), WCAP-7508-L (Proprietary) and WCAP-7685 (Nonproprietary). The nonproprietary reports are enclosed as Appendices 3A and 3B.

The Westinghouse reports describe the specific testing performed on the isolation amplifiers and include elementary diagrams of the test configuration. In addition, the Atomic Energy Commission determined the Westinghouse reports demonstrated the ability of the isolation amplifiers to perform their isolation function (References 1 and 2, page 23).

b. Data to verify that the maximum credible faults applied during the test were the maximum voltage/current to which the device could be exposed, and define how the maximum voltage/current was determined.

WPS Response:

The data requested is given in the enclosed Westinghouse reports. The maximum faults were defined as the voltages commonly present in the control room and in the racks containing the isolation equipment.

c. Data to verify that the maximum credible fault was applied to the output of the device in the transverse mode (between signal and return) and other faults were considered (i.e., open and short circuits).

WPS Response:

The data requested is given in the enclosed Westinghouse reports.

d. Define the pass/fail acceptance criteria for each type of device.

WPS Response:

While the acceptance criteria is not explicitly set forth in the test reports, the isolation amplifiers did meet the acceptance criteria of Westinghouse and the AEC (References 1 and 2, page 23).

e. Provide a commitment that the isolation devices comply with the environmental qualifications (10 CFR 50.49) and the seismic qualifications which were the basis for plant licensing.

WPS Response:

The isolation devices are located in the relay room below the control room. The relay room is a mild environment under post-accident conditions. The isolation amplifiers are qualified to operate in a mild environment. The application of original seismic testing to the isolation amplifiers is currently being researched. When the documentation has been verified, a supplement to this report will be submitted.

f. Provide a description of the measures taken to protect the safety systems from electrical interference (i.e., Electrostatic Coupling, EMI, Common Mode and Crosstalk) that may be generated by the SPDS.

WPS Response:

The operation of the SAS requires plant signals to be input from existing instrumentation and control circuitry. To protect safety systems, safety-related inputs are isolated from electrical or electronic interference through the use of isolation amplifiers. The electrical isolation provided by the isolation amplifiers ensures that neither the normal operation nor the periodic failure of any SPDS component will prevent existing instrumentation and control equipment from performing its safety-related function.

References

1. Letter from D. B. Vassallo (AEC) to R. Salvatori (W) dated June 6, 1973.
2. Letter from D. B. Vassallo (AEC) to R. Salvatori (W) dated Sept. 3, 1974.

Appendix 3A

WESTINGHOUSE TEST REPORT

WCAP 7819 Revision 1