NSP

NORTHERN STATES POWER COMPANY

MINNEAPOLIS, MINNESOTA 55401

April 11, 1980

Director of Nuclear Reactor Regulation
U S Nuclear Regulatory Commission
Washington, DC 20555

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
Docket No. 50-282 License Nos. DPR-42
50-306 DPR-60

Supplemental Information on Lessons Learned Implementation

On December 30, 1979 and March 13, 1980, Northern States Power Company supplied information on the methods by which the NRC Lessons Learned requirements were being met.

During a telephone conversation with the NRC project manager and other staff members, additional information was discussed. Attachment 1 summarizes the information provided during those discussions and provides an update on various Lessons Learned items.

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Attachment 1 to
NSP Letter dated April 11, 1980

Supplemental Information on Lessons Learned
Implementation

2.1.1 Emergency Power

Pressurizer Heaters

There are existing procedures and training that cover operation of pressurizer heaters after a loss of offsite power. The reactor operator training program "Systems and Procedures Required Knowledge Level Reference Book" identifies that the operator should be knowledgeable of the function, location, operation, logic, and control location of the pressurizer heaters.

Operation of the pressurizer heaters is described in the "Subsequent Actions" of Emergency Procedure E7, "Loss of All Offsite Power". The aforementioned operator training "...Reference Book" specifies knowledge level requirements with respect to the E7 procedure.

2.1.3.A Direct Position Indication of Pressurizer Relief and Safety Valves

Annunciator Alarms/Indications

There are several alarms and indications that a pressurizer power operated relief valve or safety has lifted. These are as follows:

(1) Each power operated relief valve has an indicator of valve position as part of the valve control switch module on the control board. Valve position indication is supplied from limit switches on the valve. A red light indicates open, a green light indicates closed.

(2) A temperature sensor mounted on the common PORV header provides indication on the control board, as well as an alarm that reads "Pressurizer Power Relief Line High Temp". This alarm is nominally set at 20F above ambient temperature. If this alarm occurs, the operator is directed to check RCS pressure to determine if a PORV should be open. If RCS pressure is such that the valve should be closed, the operator should isolate each PORV, one at a time, to determine the leaking valve.

(3) In addition, the PORV's each have an acoustic monitor which gives an "open" light indication on the control board. Also a common alarm (for safeties and PORV's) entitled "Pressurizer Safety and Relief Valve Flows" would annunciate.

(4) If a PORV lifts or is leaking, pressurizer relief tank level, temperature, and pressure might be expected to increase. There are individual indicators on the control board for each of these parameters. If any of these parameters reaches the alarm setpoint, an alarm, "Pressurizer Relief Tank High Temp/Level/Press or Low Level", would annunciate. The operator is directed to take appropriate action to control RCS leakage and the Pressurizer Relief Tank parameters within acceptable limits.

(5) Each of the pressurizer safeties has an individual temperature sensor on the downstream line. Each sensor provides indication on the control board and supplies a common alarm entitled "Pressurizer Safety Valve Line A or B High Temp". The alarm is nominally set at 20F above ambient. If the alarm annunciates, the operator is directed to determine if the safeties are or should be open and to take appropriate action.

The Prairie Island emergency procedure E20 alerts the operator that if a leaking PORV or safeties is not promptly detected, the temperature on the PORV and safety line downstream temperature indicators will all increase.

(6) A common acoustic valve position monitor was used for the pressurizer safeties for several reasons:

The required operator action is the same regardless of which safety has opened since neither safety can be isolated Thus knowing which safety has lifted has no operational significance in handling the event.

The actual piping geometry is such that a separation of vibration between the lifting safety and the other safety would be difficult to detect. Since knowledge of which safety has opened has no operational significance and because isolation of the signal is difficult, one common monitor was installed.

B and W, the monitor manufacturer, concurs that this arrangement is satisfactory.

Several procedures address the valve position. These include the operator alarm response book and emergency procedure E20 "Reactor Coolant Leak". The operator alarm response book instructs the operator to review conditions in the PRT and go to E20 if appropriate.

2.1.3.B. Instrumentation for Inadequate Core Cooling

Transmitters

The RCS pressure transmitters (wide range) which presently go to the CE subcooling meters on the control board are redundant, separately powered, but are not safety grade (non-IEEE qualified). New wide range RCS pressure transmitters which are qualified to IEEE standards (323 and 344) are on order and are scheduled for delivery in July or August. The transmitters will be installed in Unit One in August or September 1980 and in Unit Two in January 1981. The pressure channel (analog circuit loop) is being designed and procured for the new transmitters and is to be completed by 1-1-81 to complete the pressure inputs to the CE subcooling meters.

CE Subcooling Meters

The CE subcooling meters are powered by separate inverters which have separate backup battery power supplies.

For the CE subcooling meters the auctioneered highest T/C plus the auctioneered lowest pressure is used for calculating the subcooling margin [2 T/C's per meter, 2 RCS wide range pressure per meter, 2 meters per plant].

Process Computer Subcooling Program

The process computer subcooling program has the following selection logic:

A. Temperature

(1) If the reactor coolant pumps are running, RCS hot bypass loop RTD's are used [a reliable average of the four RTD's].

(2) If the reactor coolant pumps are not running, the incore thermocouples are used [a reliable average of the 39 core exit T/C's].

B. Pressure

(1) If the RCS pressure is greater than 1700 psig, the narrow range pressurizer pressure is used [a reliable average of the 3 pressure channels].

(2) If the RCS pressure is less than 1700 psig, then RCS wide range pressure is used [PT-420 hot leg wide range pressure].

All inputs to the computer are isolated from reactor protection functions.

The subcooling margin program normally updates every 30 seconds and during a reactor trip or other transient may slow down to about a two minute update. [This is based on past experience with similar priority programs].

The subcooling margin (in ^{o}F) is displayed continuously on the CRT in the control room (one for each unit).

Table 2.1.3.B-1 summarizes subcooling meter data for the plant process computer. Pages 17-26 of our March 13, 1980 letter describe uncertainties associated with: (a) P250 process computer subcooling monitor program function, (b) incore thermocouples, (c) wide range pressure, (d) bypass RTD's, (e) narrow range pressure.

INFORMATION REQUIRED ON THE SUBCOOLING METER FOR PLANT PROCESS COMPUTER

DISPLAY

Information Displayed (T-Tsat, Tsat, Press, etc.)	"Margin to T_{SAT} °F"
Display Type (Analog, Digital, CRT)	CRT or Digital on Demand
Continuous or on Demand	CRT is continuous [Also Digital is on demand typer]
Single or Redundant Display	Either of 3 CRT's
Location of Display	One in Control Rm Unit 1 One in Control Rm Unit 2 One in Control Rm S.S. Office
Alarms (include setpoints)	NONE
Overall uncertainty (°F, PSI)	See attached
Range of Display	Up to 700 °F subcooled
Qualifications (seismic, environmental, IEEE323)	NONE

CALCULATOR

Type (process computer, dedicated digital or analog calc.)	Process Computer
If process computer is used specify availability. (% of time)	> 90%
Single or redundant calculators	Single
Selection Logic (highest T., lowest press)	Avg. Temp, Avg Pressure
Qualifications (seismic, environmental, IEEE323)	NONE
Calculational Technique (Steam Tables, Functional Fit, ranges)	Functional Fit

INPUT

Temperature (RTD's or T/C's)	RTD's w/RCP's running T/C's w/RCP's not running
Temperature (number of sensors and locations)	4 RTD's, 39 T/C's
Range of temperature sensors	RTD's 520 - 620°F T/C's 100 - 1375 °F
Uncertainty* of temperature sensors (°F at 1)	RTD's 1.9°F T/C's 10.7°F See attached
Qualifications (seismic, environmental, IEEE323)	RTD's - seismic, environmental. T/C's - None
Pressure (specify instrument used)	Narrow Range 1700-2500 psig Wide Range 0-3000 psig

*Uncertainties must address conditions of forced flow and natural circulation

Pressure (number of sensors and locations)	3 narrow range 1 wide range
Range of Pressure sensors	Narrow 1700-2500 psig Wide 0-3000 psig
Uncertainty* of pressure sensors (PSI at 1)	Narrow 11.13 psig Wide 24 psig
Qualifications (seismic, environmental, IEEE323)	Narrow - Seismic, Environmental. Wide - None

BACKUP CAPABILITY

Availability of Temp & Press	2 CE Subcooling meters/unit 3 Narrow Press 2 Wide press 2 wide RTD's, 39 Core Exit T/C's
Availability of Steam Tables etc.	Yes, plus a press, temp curve in control room
Training of operators	Yes
Procedures	Yes

*Uncertainties must address conditions of forced flow and natural circulation

Process Computer

The process computers (for Units one and two) are powered by separate (16 for Unit 1, 26 for Unit 2) inverters which have individual battery backup sources. Refer to the FSAR Figure 8.3-3 for typical one line electrical diagrams of the 125 vdc and 120 vac instrument supply system.

The availability of the plant process computers is known to be greater than 90% but it is not known exactly what the availability is. The 75 point program includes some inputs to the subcooling program so a margin can be calculated by the other unit's computer but it is not done automatically or continuously.

Subcooling Margin Calculation Procedure

We have as part of E1.1 a procedure on calculating subcooling margin as a backup to our other 3 methods. The selection logic for the operator is the same as for the process computer.

Future Instrument Configuration

Our final configuration of subcooling meters is dependent on a decision by the NRC steering committee on whether we can use 4 T/C's as inputs or if 8 is required. Since our core crossection is half of the larger four loop plant cores [50 ft^2 as opposed to 96 ft^2] less area needs to be monitored for local effects. Our long range plans are for 2 redundant pressure inputs [safety grade IEEE qualified], one per meter, and also class IE, IEEE qualified core exist thermocouples, 2 per meter.

2.1.4 Diverse Containment Isolation

The nitrogen piping used for accumulator pressurization and depressurization is shown in FSAR Figure 6.2-1. The single air operated valve (CV-31440 for Unit 1, and CV-31554 for Unit 2) is isolated by a train A containment isolation (T) signal. Since instrument air to containment isolates upon T actuation, the nitrogen supply valves to each accumulator and the common depressurization valve, if open, should fail in the closed position.

Since a second valve does not receive a separate containment isolation signal, a procedure change will be made requiring a dedicated operator for accumulator pressurization and depressurization, effective April 15, 1980. This procedure change will be applicable whenever containment integrity is required.

All containment isolation valves are electrically separated into Trains A and B. However, in the case of the containment purge valves there is a common control switch that affects both Train A and B containment purge valves. This switch allows the operator to line up Unit 1 or Unit 2 containment purge supply and exhaust paths or place the system in the off condition. Since there might be a very remote possibility for electrical interaction between Trains A and B, several actions will be taken. The

instrument air supplies to these valves will remain isolated. Since air is the motive force for opening these valves, air isolation prevents the valves from opening, no matter what happens to the switch. In addition, the power supply fuses to the common switch will be removed, thereby eliminating any possibility of electrical interaction between the separate trains. These corrective actions will be taken when containment integrity is required and will remain in effect until electrical separation can be assured.

2.1.5.A Dedicated H_2 Control Penetrations

Figure 2.1.5.A-1 of our March 13, 1980 letter illustrated the flow paths for supply and exhaust of the Post-LOCA system. Manually controlled valves in this system have been determined to be accessible during Post-LOCA conditions.

Evaluation of containment hydrogen concentrations is based on the method described in Section 2.1.8.a of our March 13, 1980 letter. The gas analyzer is presently located in the sample room which would be accessible during post accident conditions. We may be required to move the gas analyzer in order to make room for a manipulator currently being manufactured. In the event that the gas analyzer is relocated, it will be made accessible during post accident conditions.

2.1.6.B PLANT SHIELDING REVIEW

Prior to 1-1-80 a design review of plant equipment qualification to a radiation environment with NuReg 0578 source terms (except containment sump recycle water as per the Westinghouse Owners Group recommendation was assumed degased) was completed. This study utilized original purchase specifications and Westinghouse WCAP's as documentation. However, this study indicated additional studies must be completed requiring some additional amount of time.

The following systems have been the subject of this study: Residual Heat Removal System (RHR), High Pressure Safety Injection System (SI), Containment Internal Spray System (CS), Coolant Sampling System, Shield Building Ventilation, Auxiliary Building Special Ventilation System and Post LOCA Hydrogen Control System.

The initial step in locating the documentation to verify the radiation qualification of plant components was to look at the original purchase orders. This included looking at all of the original purchase order specifications and the QA related correspondances between NSP, Pioneer Services and Engineering, Architect Engineer; Westinghouse Electric Corp. Nuclear Steam System Supplier; and the individual vendors. Since in some cases radiation was not addressed in the specifications, the decision was made to gather further documentation for all components.

Certain types of motor inculation may be vulnerable to radiation. The RHR pump motors and the SI pump motors were supplied by Westinghouse Electric Corporation. Westinghouse has issued WCAP-8754, Environmental Qualification of Class IE Motors for Nuclear Out-Of-Containment Use which addresses radiation endurance. The copy of WCAP-8754 on site, however, is missing some pages (one of which is the page addressing radiation endurance). Westinghouse has given verbal confirmation of a value of 2×10^8 Rads for their motors. Westinghouse will be sending a copy of the missing information. The containment internal spray pump motors were supplied by Electric Machinery Manufacturing Company. The original purchase order specified motor insulation for 1×10^8 Rads. Electric Machinery was contacted to confirm this. Correspondance from Mr. B.A. Bondow of Electric Machinery to Joe Sorensen of NSP confirming the value of 1×10^8 Rads has been received on-site. The original purchase order on the shield building exhaust fans specified total radiation dose of 1×10^7 Rads gamma radiation. Documentation confirming this is also available on-site.

Certain pump components such as seals, o-rings, gaskets, etc. may be vulnerable to radiation. In order to confirm that these materials will not fail due to radiation in the event of a DBA the following has been done. The pump manufacturers have been contacted. This includes Byron-Jackson for the RHR pumps, Bingham-Willamette for the SI pumps, and Ingersoll-Rand for the CS pumps. All three manufacturers stated that actual running tests under a radiation field were not done for the particular model pump. The manufacturers were then requested to supply the plant with a list of the vulnerable materials and the qualification of each material. This information has not yet arrived on-site. In addition to this, the plant has contacted the mechanical seal manufacturers for each pump. This includes the John Crane Company for the RHR and SI pumps, and Duramettalic Corporation for the CS pump. Information on the radiation qualification of the materials used in the seals was given over the telephone. Actual documentation has not yet arrived on-site.

In the case of the John Crane seals, most of the materials will hold up to radiation levels of at least 1×10^8 Rads. There is a gasket, however, which contains 1-2% Buna N as a binder. The value for Buna N is 1×10^6 Rad. This item will be further pursued and replacement may be required.

The Duramettalic seals supplied with the CS pumps use teflon for the secondary sealing elements. Teflon has a relatively low threshold to radiation damage. Replacement of these secondary sealing elements will probably be required.

The lubricants used in the pumps and motors has also been investigated. Operations Manual Section D18, Equipment Lubrication, specifies what lubricant is to be used in each plant component. Mobil DTE light and heavy medium is used in the SI and CS pumps and motors. The RHR motor uses Mobil DTE heavy medium and Chevron SRI-2. Mobil and Chevron were contacted and letters have been received on-site. The Mobil DTE oils have been tested satisfactorily to 1×10^8 Rads. Chevron states they would expect the SRI-2 grease to be satisfactory at least to 5×10^8 Rads.

The valves for the RHR, SI, and CS systems have also been investigated. Motor operators were qualified under Bulletin 79-01B. The actual valve materials were investigated under this evaluation. In order to determine what materials are present in each valve, the drawings were checked. Then a review of maintenance files was made to determine if the valve had been repacked with a material different from its original packing. Valve packing manufacturers were contacted to determine the radiation qualification of the packing. Grafoil packing has been tested satisfactorily to 1.5×10^9 Rads. John Crane Packing 187I is good to 1×10^7 Rads. Manufacturers' correspondence is available on-site. The value of 1×10^7 Rads is satisfactory for most applications with the exception of the RHR system. Most of the valves in the RHR system have already been repacked with Grafoil. An effort is presently underway to repack with Grafoil all the valves in the RHR, SI, and CS systems that may be in contact with highly radioactive fluids in the event of a DBA.

2.1.6.B (cont.)

Flexitallic gaskets are used in many of the valves. A qualification for these gaskets has not yet been located. Flexitallic Gasket Company has been contacted by both the plant and Fluor Power Services. Flexitallic Gasket Company did not have any information concerning radiation damage to Flexitallic gaskets. Fluor Power Services, Inc. will continue to pursue this matter and advise the plant as soon as possible.

Control valves and operators for the Post LOCA H_2 control system are being investigated. Original purchase orders specified that the valve and actuator design shall be sufficient for operation in an environment of 5×10^7 Rads integrated gamma radiation does. Contromatics Corporation, the supplier of these valves, has been contacted. Information confirming this qualification has not yet arrived on-site.

Further investigation of the valves in the sampling system has not yet been completed. An investigation of sealing materials used in heat exchangers, flanges, etc. in the RHR, SI, and CS systems is also underway.

The qualification of the electrical components is part of the response to NRC Bulletin 79-01B. Initial response to that bulletin has been sent to the NRC. Another response is due in April.

We will complete this reevaluation study by 7-1-80. Part of the delay in completing this study is that some information from the equipment vendors is needed. We are going to the extent of valve-by-valve determinations of qualification which requires a significant effort.

It should be noted that most of the continuing qualification investigation is aimed at assuring leak protection. We feel the investigation completed to this point will assure system operability after completion of a few remaining open items.

2.1.8.a POST ACCIDENT SAMPLING

The sampling of the Reactor Coolant System and the Containment Building atmosphere is not limited to a time delay after the accident. In other words, sampling could take place immediately after an accident without exceeding personnel exposure limits.

2.1.8.b INCREASED RANGE OF RADIATION MONITORS

The containment vent, or post-LOCA hydrogen control system, at Prairie Island is designed to vent containment gas into the annulus which is purified by the Shield Building Vent System. The Shield Building Vent System maintains a slight negative pressure in this annulus region. The inleakage into the annulus is discharged via the Shield Building Vent. The Auxiliary Building Special Vent system also discharges to the Shield Building Vent. This vent, one for each unit, is sampled by two monitors, one low level located in the Auxiliary Building, and one high level located in the Turbine Building.

In the Turbine Building monitor, silver zeolite filters will be used to sample for iodines to reduce the occupational source posed by noble gases collecting on charcoal filter media. Portable shields are being constructed that will be available if the sample media is greater than 10 mR/hr.

Sample media will be counted on the Prairie Island mobile GeLi system. The mobile GeLi is calibrated for high activity samples. The use of silver zeolite should reduce the rad levels on the sample media. The mobile GeLi system can run on plant power or it is equipped with a backup generator system. If the normal location of the mobile GeLi is in a high background area at the time, it can be easily moved to a low background area. The mobile GeLi receives a weekly calibration check with a NBS traceable standard.

The interim procedures for estimating noble gas release rates utilizes the portable equipment discussed below until the monitoring system design changes are completed:

A. Eberline Teletector Total Model 6112

1. Range -0.1 mr/hr to 1000 r/hr
2. Sensitivity -0.1 mr/hr
3. Energy Dependence ± 20%
4. Calibration Frequency - semiannually with sources traceable to NBS

B. Eberline RM-14 with HP-210 Probe (For Low Range Only)

1. Range 0 to 50,000 cpm
2. Sensitivity - 50 cpm
3. Calibration Frequency - Semiannually with electronic and source calibration traceable to NBS

C. Eberline PIC-6A

1. Range, 1 mr/hr to 1000 r/hr
2. Sensitivity 1 mr/hr
3. Energy Dependence ± 10% from 60 KEV to 1.3 MEV
4. Calibration Frequency - Semiannually with sources traceable to NBS

D. Victoreen Cutie Pie Model 740

1. Range 1 mr/hr to 25 r/hr
2. Sensitivity - 1 mr/hr
3. Accuracy ± 10%
4. Energy Dependence ± 10% from 7 KEV to 2 MEV
5. Calibration Frequency - Semiannually with sources traceable to NBS

The interim Shield Building Vent release estimate procedure uses the above equipment to measure the radiation levels from a Marinelli type container. This radiation level is calibrated to Xe-133 equivalent concentration. This calibration method utilized the gamma dose factors from the Prairie Island off-site Dose Calculation Manual. It was calibrated with gas obtained from the waste gas system and the Volume Control Tank gas space. The in-plant GeLi system was used to determine the concentrations. The discharge flow rate is based on the Auxiliary Building Special Vent system flow rate of about 5000 CFM in each of two vents.

The air ejector discharge is equipped with a low range radiation monitor. For high range releases, the portable equipment described above will be used to measure the dose rate at a certain point on the air ejector line. A section of identical pipe was used as a calibration geometry. Using methods similar to the shield building vent calibration procedure, radioactive gases were placed in a pipe and radiation levels were measured. The radiation levels are plotted against the Xe-133 equivalent activity. The pipe wall is thin enough that absorption of the low energy gamma from Xe-133 was not a problem. The air ejector discharge flow rate indicates locally and in the Control Room.

The main steam power operated relief and the main steam safeties can be monitored for radioactive noble gas releases by portable instruments only. The thickness of the pipe shields much of the Xe-133 low energy gamma. However, as an interim measure, Fluor Power Services, Inc., calculated a dose rate versus Xe-133 activity conversion factor that can be used for the short term after a reactor trip. They are in the process of developing a curve of the ratio of radiation level to Xe-133 equivalent activity with time after a reactor trip. (In that way, all plant noble gas discharges can be summed in Curies of Xe-133 to calculate off-site doses.) This curve should be available for use by 4-15-80. The steam discharge flow rates are estimated by assuming full flow from the safety or power operated reliefs whenever they are open. Time lapse indicators are available on the power operated reliefs and steam dumps. The time lapse indicators receive their signal from limit switches on the valves. There is an installed RTD on the stack from each safety valve. These RTD's are utilized to identify which valves are open. They read out on the plant computer. Two improvements are being made presently to the steam release analysis: 1. to add a collimator next to the steam line 2. a new curve is being generated to convert from dose rate obtained through the collimator to release concentration versus time.

2.1.8.c IMPROVED IN-PLANT RADIO-IODINE MONITORING

Presently iodine and particulate continuous air monitors (CAM'S) are available to the control room and Technical Support Center for post-accident air monitoring. These CAM'S are equipped with silver zeolite cartridges. The iodine portion of the CAM'S are equipped with single channel analyzers set for the Iodine-131 peak at 365 KeV.

Portable samplers are available for obtaining iodine and particulate samples in any other vital area of the plant. These samples will then be counted in a mobile GeLi system located at Prairie Island. The mobile GeLi system is operable and calibrated. Operating procedures and preliminary training have been completed on the mobile GeLi system.

2.2.2.B ONSITE TECHNICAL SUPPORT CENTER

The notebook containing flow diagrams, computer addresses, instrument numbers, control room control board identification numbers, and ranges for the parameters needed for accident assessment will be in place in the TSC by 7-1-80.