REED COLLEGE Portland, Oregon 97202-8199

REACTOR FACILITY

March 30, 1992

To: John B. Martin,
NRC Regional Administrator
From: Michael Pollock,
Acting Director, Reed Reactor Facility
Re: Amendments to Recovery Plan for Reed Reactor Facility

The attached document is a set of amendments to the original Recovery Plan submitted by Reed College to the Nuclear Regulatory Commission on March 17, 1992. These amendments were prepared at the request of Phil Qualls, Jim Reese, and Marvin Mendonca of the NRC.

If you have any additional questions or comments regarding these amendments or the Recovery Plan, please contact either Michael Pollock, Acting Director, or Paul Terdal, Associate Director, at (503)777-7222.

for Michael Pollock,
Acting Director, Reed Reactor Facility

March 30, 1992

Reed Reactor Facility
Recovery Plan
Amendments

Introduction:
This document contains a set of amendments to the Reed Reactor Facility Recovery Plan of March 17, 1992, based on discussions between Reed and NRC personnel. These amendments clarify items in the original Recovery Plan.

Procedure for Locating the Leaking Fuel Element:
In the original Recovery Plan, in Step 1, we stated that we would "operate the reactor at the lowest power level that will produce a reasonably detectable amount of fission product." We will determine this level as follows:
1) As required by Standard Operating Procedures, the reactor power level will be brought up to 5 W for a core excess check. The sniffer will be used, with a "wide area" funnel to attempt to identify fission products. If, after at least one hour of operation at this power level, fission product activity is below the detection limits of our apparatus, the power level will be increased to 100 watts.
2) The procedure will be repeated at 100 watts, 1,000 watts, 10,000 watts, 100,000 watts, and 240,000 watts until a power level is reached which produces a detectable level of fission products.
3) If, after five hours of operation at 240,000 watts, no detectable levels of fission products are found, the reactor will be shut down, and operations to locate the fuel element leak will be suspended pending consultation with the NRC.

The primary cooling system will be turned off while the sniffer is in use, in order to reduce water currents in the pool.

The sniffer is designed to maintain the reactor water in a closed loop, which will be returned to the bottom of the reactor tank, except for a three way valve which will allow collection of small volumes of water in beakers for detailed analysis. These beakers will be covered as they are filled.

All operation for this procedure will be directly supervised by either the Director or Associate Director. As stated above, the reactor will be shut down if the RAM, CAM, APM, or GSM enters the failsafe mode, and the staff will evaluate the situation. If unexpected and potentially hazardous situations arise, such as an alarm on the RAM, CAM, APM, or GSM, the NRC will be contacted for consultation. If the staff is unable to locate the fuel element leak through the procedures outlined herein and in the original Recovery Plan, the NRC will be consulted before other approaches are attempted.

Gaseous Stack Monitor Calibration:
In the March 17 Recovery Plan, in response to a concern raised in the NRC Inspection Report 50-288/91-01 that some of the instrument calibrations were out of date, we stated that "prior to any attempts to operate the reactor for the

purpose of locating the source of the fuel leak, the CAM, APM, and GSM will be recalibrated."

Although our facility Standard Operating Procedures call for semiannual calibration, the Technical Specifications only require annual calibration for the GSM. The GSM Calibration Procedure requires Ar-41 gas, which is normally produced in our own reactor. We have been unable to find a vendor who is able to supply us with this material. While the reactor at Oregon State University could be used to produce this material, DOT regulations regarding transportation of radioactive gases make its shipment very difficult. Because the most recent GSM calibration is still valid (according to the Technical Specifications), we propose to begin operations to find the fuel element leak without recalibrating this instrument. However, we would prefer to redo the calibration. During the initial leak testing at 100 W, we will irradiate the necessary Ar gas for calibration of the GSM in the rotary specimen rack. If no significantly elevated levels of radioactivity are found in the Reactor Bay or stack, then the reactor will be shut down and the stack monitoring system will be taken out of service for calibration. Operations to locate the leaking fuel element will be resumed after the GSM calibration has been completed and the stack monitoring system has been returned to service.

Air Particulate Monitor:
In the original Recovery Plan, we indicated that we would move the APM collector out of the Reactor Bay and into the exit corridor. We have reviewed the Safety Analysis Report and Technical Specifications, and there is no statement specifying the location of the collector. A 50.59 review is therefore unnecessary.

Continuous Air Monitor:
The CAM air intake is currently located in a pipe trench the reactor tank, a few inches above water level. When the facility enters isolation mode, there is a steady stream of air through the pipe trench into the reactor bay, which could effect the CAM readings. In the original Recovery Plan, we stated that we would move the CAM several feet so that it was out of the pipe trench, but still in the reactor tank area itself.

According to the SAR and Technical Specifications, the CAM "shall be operable in the reactor room when the reactor is operating." It does not specify where in the room the CAM or its air intake must be located. We feel that the primary purpose of the CAM is to alert personnel in the Reactor Bay to excessive concentrations of airborne contamination. Because the reactor tank will be covered during the procedure, the level of airborne contaminants in the space immediately above the pool, but beneath the covers (where the CAM currently samples air) will be higher than that in the room itself. We propose to move the CAM air intake out of this area, so that it properly samples room air from near the breathing zone of the workers. One litre grab samples of air from beneath the cover will be taken at the end of each hour of reactor operation and analyzed prior to bringing the reactor up to the next higher power level (see the amended "Procedure for Locating the Leaking Fuel Element," above).

Air Monitoring:
In the original Recovery Plan, we stated that "(charcoal cartridges) would be collected at routine intervals and analyzed for particulate and iodine activity in the air." It is our intention to run this sampler at all times that the reactor is operating. Filters and charcoal cartridges will be changed and analyzed at least once each hour of reactor operation.

Isolation Mode Test:
On From Friday, March 27 at 1800 to Monday, March 30, at 1000, the facility ventilation system was placed into isolation mode in an experiment to determine the impact on humidity levels and background radiation levels in the Reactor Bay. Although the air became quite stale, as expected, no excessive humidity buildup was observed. Background radiation levels on the four main facility radiation monitors were as follows:

Monitor:	Background:
RAM	0.08mR/hr
APM	1800 cpm
GSM	70 cpm
CAM	800 cpm

None of these levels is considered excessive.

Action Levels:
The Failsafe and Alarm levels on the Continuous Air Monitor, the Gaseous Stack Monitor, and the Air Particulate Monitor will be changed to bring them in line with current regulatory practice and to make them consistent with the definition of Unusual Event, as outlined in the Emergency Plan for the Reed Reactor Facility. If, during the operations, the Failsafe on any of the monitors is reached, the reactor will be shut down and the staff will review the situation. If an Alarm level is reached, the NRC will be notified and no further operations will be taken to find the source of the fuel leak without the concurrence of the NRC.

<u>RAM:</u>
The current Failsafe setpoint on the RAM is 0.5 mR/hr, and the current Alarm level is 2.0 mR/hr. These will not be changed.

<u>GSM:</u>
For the purposes of locating the fuel element leak, the Standard Operating Procedure for Gaseous Stack Monitor Calibrations, SOP-31, will be modified as follows:

1) The Alarm and Failsafe setpoints will be determined by the following formulas:

Alarm = (10xMPC)(K)/((1/24)(F)) + Background

Failsafe = (MPC)(K)/((1/24)(F)) + Background

Where:

K = dispersion factor (11.6)

F = detector efficiency (1.6×10^{-7} µCi/cpm ml)

MPC = Maximum Permissible Concentration (2.29×10^{-7}, as described above)

Background = 50 cpm

2) The MPC (Maximum Permissible Concentration) will be $2.29\times10^{-7}\mu Ci/ml$ which is based on the following assumed isotopic composition:

53% Xe-135
30% Kr-88
17% Kr-85m

3) The dispersion factor, K, will be 11.6

Explanation:

As reported in the NRC inspection report, the breakdown on the gases released during the Unusual Event last Fall is believed to have been 53% Xe-135, 30% Kr-88, and 17% Kr-85m. Prior to the release, the GSM was reading background (50 cpm), indicating that no substantial Ar-41 release was taking place. Following the procedures in 10CFR20 Appendix B paragraph 1, "If radionuclides A, B, and C are present in concentrations C_A, C_B, and C_C, and if the applicable MPC's are MPC_A, MPC_B, and MPC_C, respectively, then the concentrations shall be limited so that the following relationship exists: $(C_A/MPC_A)+(C_B/MPC_B)+(C_C/MPC_C) <= 1$"

Nuclide:	Percent Abundance:	MPC:
135Xe	53%	1×10^{-7} µCi/ml
88Kr	30%	2×10^{-8} µCi/ml
85mKr	17%	1×10^{-7} µCi/ml

Thus, the combined "MPC," as used for determining the GSM alarm setpoint, would be:

$(0.53\times1\times10^{-7}\ \mu Ci/ml)+(0.30\times2\times10^{-8}\ \mu Ci/ml)+(0.17\times1\times10^{-7}\mu Cil/ml)$

$= 2.29\times10^{-7}\mu Ci/ml$

The Unusual Event level of 10xMPC would be $2\times10^{-6}\mu Ci/ml$.

Because the Unusual Event limitations are placed on the Site Boundary, which is 250 feet from the stack, we propose that we incorporate an air dispersion factor of 11.6. This dispersion factor was accepted in a 50.59 review of the Gaseous Stack Monitor procedure dated April 26, 1990, based on dispersion from the top of the stack to the ground. Actual dispersion from the top of the stack to a point 250 feet away would be much greater, so this is still a highly conservative value. Also, because the MPC is based on averaged release over 24 hours, we propose that we assume 1 hour of release at the Alarm level in a 24 hour period (our current procedure, which is aimed at Ar-41 release, is more liberal that this; it assumes 4 hours of release at Alarm level in a one week period).

Using the data from the most recent official calibrations, then, the Failsafe Setpoint would thus be 450 cpm, and the Alarm setpoint would be 4000 cpm.

CAM:
For the purposes of locating the fuel element leak, the Standard Operating Procedure on Continuous Air Monitor Calibration (SOP-30) will be changed to use the following formulas for determination of the Failsafe and Alarm setpoints:

Failsafe setpoint = 24 x E_f F t MPC E_d + Background cpm
Alarm setpoint = 24 x 10 x E_f F t MPC E_d + Background cpm

Where:

E_f = Paper filter efficiency (percent of particles trapped by filter - 52%)
F = flow rate in milliliters per minute
t = sample time (60 minutes)
MPC = Maximum Permissible Concentration from 10CFR20
E_d = Detector Efficiency
Background cpm = background reading from chart recorder

The facility will use $3\times10^{-10}\mu Ci/ml$ (6.66×10^{-4} dpm/ml) as the Maximum Permissible Concentration.

Explanation:
Currently, the official CAM Alarm Setpoint is arbitrarily set to 3600 CPM, and the Failsafe to 3000 CPM. These points were chosen simply because the self test feature will only generate 3600 cpm, and it is thus convenient to test these levels.

As with the Gaseous Stack Monitor (GSM), discussed above, these equations are based around the definition of "Unusual Event" from our Emergency Plan. As with the GSM, the Alarm level is based on 10x MPC averaged over 24 hours. This equation is more conservative than the GSM equation, however, because dispersion is not taken into consideration. For the MPC value, since we won't always know exactly what we are faced with, we propose using the values from 10CFR20, Appendix B, paragraph 3c, which specifies limits "when the exact composition is unknown, but that it is known that certain elements are not present." Assuming that Pb 210, Ac 227, Ra 228, Pa 230, Pu 241, and alpha emitters are not present, but the exact composition is otherwise unknown, we can us an MPC of $3\times10^{-10}\mu Ci/ml$ in the reactor room, and $1\times10^{-11}\mu Ci/ml$ outside the facility. During the Unusual Event, none of the restricted elements listed above were detected in water or air filter samples.

The equation outlined above would give us some very high setpoints; using the following data (collected during a recent calibration exercise):

E_f = 0.52 (according to the manufacturer)
F = 1.8×10^5 ml/minute
t = 60 minutes
MPC = $3\times10^{-10}\mu Ci/ml$ (6.66×10^{-4} dpm/ml)
E_d = 0.091 cps/dps
Background cpm = 800 cpm (for isolation mode)

we get a failsafe setpoint of about 9,000 cpm and an alarm setpoint of 83,000 cpm. If dispersion were taken into account, the setpoints would be even higher. Since the top of the scale on the CAM is 50,000 cpm, we will use an alarm setpoint of 45,000 cpm. We can generate readings of 50,000 cpm with either a Coleman lantern mantle or some other small detector check source to verify that these settings are correct.

APM:

For the purposes of locating the fuel element leak, the Standard Operating Procedure on APM Calibration (SOP-32) will be changed to use the following formulas for determination of the Failsafe and Alarm setpoints:

Failsafe setpoint = (24)E_f F t MPC E_d + Background cpm
Alarm setpoint = (24)(10)E_f F t MPC E_d + Background cpm

Where:

E_f = Paper filter efficiency (percent of particles trapped by filter - 52%)
F= flow rate in milliliters per minute
t = sample time (60 minutes)
MPC = Maximum Permissible Concentration, from 10CFR20 but
expressed in dpm/ml instead of μCi/ml
E_d = Detector Efficiency
Background cpm = background reading from chart recorder

The facility will use 1×10^{-10}μCi/ml (2.22×10^{-4} dpm/ml) as the Maximum Permissible Concentration.

Explanation:

Originally, the APM alarm level was based arbitrarily on release of Sr 90. Also, the APM used a moving filter paper, so the "t" in the above calculation would have been about 1 minute instead of 60. Filter paper efficiency was assumed to be absolute (100%). Since then, the APM has been modified to use fixed filter paper, which will accumulate particles throughout an entire run, and so radiation levels are considerably higher than before. Since the APM functions very much like the CAM, we can use the same efficiency equation to determine the setpoints. However, unlike the CAM, we consider it very unlikely that there will be Sr-90 in the stack air. The parent for Sr-90 is Kr-90, which has a very short half life (about 33 seconds). For the most part, then, if any Sr-90 is produced (none was observed last November), the bulk of it will be produced in the Reactor Bay. Since the room will be in isolation, the Sr-90 will be filtered out by the HEPA filter before it reaches the stack. Therefore, we can use a less restrictive MPC limit from 10CFR20, which is 1×10^{-10}μCi/ml. Using sample data from a recent APM calibration, with a background of about 3000 cpm, this gives us:

Failsafe = 5700 cpm
Alarm = 30,000 cpm

Since the APM readout goes up to 1,000,000 cpm, both of these setpoints can realistically be used. If we took dispersion into account, the setpoints would be

even higher. Actual setpoints will be based on a new calibration of the instrument.

Respirators:
In the original Recovery Plan, we indicated that "full face respirators with charcoal activated filters will be made available, as needed, for facility staff working in the Reactor Bay." Any individuals wearing these masks will be properly fit tested, trained, and certified for their use. Availability of the masks is purely a precaution in keeping with our ALARA policy; we do not intend to use these masks to allow personnel to enter areas with airborne concentrations in excess of the concentrations specified in 10CFR20.

If radioactive iodine is detected in the Reactor Bay air, operations will cease, the reactor will be shut down, and the NRC will be consulted before operations resume.

Arrangements have been made with Portland General Electric for use of their whole body counters to examine personnel who have been working in the reactor bay in the event that airborne particulate or iodine contamination levels rise above background.

Fuel Element Inspections:
We are very concerned about the request to visually inspect all fuel elements. We have visually inspected at least 1/5 of the fuel elements in the reactor each year for more than 20 years. Visual inspection is very subjective and there are no criteria upon which to decide whether or not a fuel element is acceptable. Information from several other facilities which have experienced pin-hole leaks suggests that the sources of these leaks are not visible.

The only deterioration of fuel elements which has been noted over the years are physical scratches, mostly along the long dimension of the elements, and a bent bottom pin. The deterioration in each case has occurred during the process of handling fuel. Other than fuel element inspections, the only fuel handling which has ever occurred at Reed has been the movement of at most 3-4 elements during the rare process of adding fuel elements to the core. It makes very little sense to us to agree to arbitrarily perform the one operation which is most likely to cause the failure of an element, particularly if there is no benefit to be gained.

Never-the-less, we will agree to the following:

1) Any fuel element which is handled during the process of identifying the leaking element will be subjected to a careful visual inspection.

2) Once the leaking element(s) is identified, it will be subjected to a careful visual inspection by at least two individuals and the results discussed in detail with the NRC and General Atomic.

3) If, during the review, identification and evaluation process, any criteria is identified which would allow one to identify other elements which may have a

higher potential to develop leaks in the future, we will inspect all fuel elements against those criteria prior to resuming routine operation.

Additionally, as was stated in our original Recovery Plan, the annual inspection of 1/5 of the elements in the core will take place after the leaking element has been located and removed from the core.

Disposition of Leaking Fuel Element:
After the leaking fuel element has been found and examined through our normal fuel inspection procedure, it will be placed in an in pool storage rack. Should the manufacturer wish to inspect it, we will make it available to them.

A note will be made in the fuel inventory records for the leaking fuel element to indicate that it should not be returned to service.

Control Rod Inspections:
As was stated in the original Recovery Plan, the Control Rod Inspections will be conducted after the leaking fuel element has been located and removed from the core. In order to inspect control rods, we must remove several fuel elements from the reactor core, in order to keep the reactivity shutdown margin intact. As we have stated above, we would prefer to keep fuel handling to a minimum for safety reasons, and would rather do this at the same time as the annual fuel inspections.

Public Information:
All information relating to fuel element leak, our correspondence with the NRC, and our plans for restarting the reactor are available to the public. Copies of all regulatory documents and correspondence relating to the reactor have been placed on file in the reserve room of the College library and are available to anyone upon request.

Notification of the submission of the Recovery Plan to the NRC has been published in the campus newsletter, and submitted to the student newspaper. Copies have been provided to the neighborhood organizations and to those media sources which have requested them. All college constituents, including parents of students, have been notified.

A public meeting was held on February 13, to which all residents of the three neighborhoods surrounding the Reed campus were invited. The neighborhood associations will be given an opportunity to comment on the plan in a mutually agreeable format.