NATIONAL BUREAU OF STANDARDS REACTOR

Docket #50-184

Facility License No. TR-5

Operations Report

- - #37 ---

January 1, 1984 - December 31, 1984

This report contains a summary of activities connected with the operations of the NBSR. It is submitted in fulfillment of section 7.8(3) of the NBSR Technical Specifications and covers the period from January 1, 1984 to December 31, 1984.

Section numbers in the report (such as 7.8(3)(a) correspond to those used in the Technical Specifications.

April 3, 1985

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7.8(3)(a) Summary of Plant Operations

During the calendar year 1984, the reactor was critical for 4263.5 hours and the energy generated was 42163.3 MWH.

The reactor was shutdown on September 7, 1984 for conversion to 20 MW. This involved increasing primary flow by about 50% and re-ranging some of the process instrumentation. Numerous items of improvements, maintenance and repair were also scheduled during this shutdown which was expected to last about 6 months. Listed below are major highlights of both the conversion and improvements. Some of the items extended into 1985 but are included here for completeness.

1. Conversion

a. The impellers on the 3 main primary pumps were changed. Regular size 13" impellers were installed in place of the smaller 12-3/8" impellers.

b. Pump motors were changed to accommodate the regular size impellers.

c. A fourth primary pump was added to the system in its originally designed place and will serve as a spare.

d. The second main heat exchanger was connected into the system.

e. Associated flow and temperature instrumentation were re-ranged to accommodate the new levels.

f. The layout of the console control panel was changed to reflect better ergonomic design.

2. General Improvements

a. Instrumentation

The program of upgrading and improving reactor instrumentation is continuing. Most of the old recorders were replaced with new up-to-date units. Flow and temperature transmitters are being replaced and updated. The tritium monitor was replaced with a modern electrometer. Instrumentation cabling was replaced with radiation resistant material to reduce exposure during maintenance and calibration. Additional instrumentation were installed such as flow and temperature indications for individual main heat exchangers to provide more information to the operator.

b. Replacement of Heavy Water

The entire system inventory of heavy water was replaced with fresh low tritium heavy water solely in order to reduce exposures and releases. The replaced heavy water was of high purity and had only 1.24 mCi/ml, tritium well within acceptable limits.

c. Removal of Check Valves

Past experience with some of the larger check valves has not been very good. Several had been found damaged or broken. In order to preclude future failures, the two plena check valves and the pump discharge check valves were removed. The plena control valves and the pump automatic discharge valves will be used to control flow if needed.

d. Installation of Two Additional Primary Ion Exchange Columns

Two new primary ion exchange columns identical to the existing ones were installed. This will remove the necessity of handling highly radioactive resins and allowing them to decay thereby reducing exposures. Additional shielding was also installed at the old and new columns to further reduce personnel exposures.

e. Improved Tightness of the Confinement Building

The confinement building air leak rate was reduced to a level lower than had ever existed previously by reworking all personnel doors and the truck door and repairing all known leaks. The building now exceeds the requirements for tightness by a factor of two.

f. Repair of Thermal Shield Cooling System

The thermal shield cooling system was extensively checked and reworked in order to isolate and repair the leaks from this system. The new risers which were installed have reduced leaks considerably. Subsequently, each individual coil was tested to identify leakers which were then shut off. This test was repeated so that all known leaking coils were identified and isolated.

g. Cleaning and Repair of the Main Heat Exchangers

The main heat exchanger which has been in use for about 9 years showed a reduction in its efficiency due to fouling. The heat exchanger along with two small auxiliary exchangers were chemically cleaned. The main heat exchanger showed marked improvement in efficiency following the cleaning. Prior to the cleaning, the primary side of the heat exchanger was pressurized with air to prevent any leakage of cleaning chemicals to the primary side. During pressurization, leakage of air from the primary side to the secondary was detected. Each tube was individually tested and all suspect tubes were plugged. In all, 15 tubes of more than 1100 were plugged. Extensive testing revealed no remaining leaks.

h. Replacement of Tips for Pneumatic Tubes

The tips of pneumatic tubes RT-1 and RT-2 were removed and new tips were fabricated. The new tips were designed such that they will be

located in a superior flux environment. The new tip for RT-1 was satisfactory and passed all inspections and was installed. However, the tip for RT-2 was not satisfactory and therefore was not installed. A shield plug was installed in its place. The tip will be repaired or re-fabricated and inserted during a later shutdown.

i. Relocation of the Emergency Control Station

The Emergency Control Station was moved from its existing location to the basement of the office portion of the building. The new location is more functional and accessible. All of the instrumentation and controls were also transferred to the new location. Better communications will also be provided.

j. Regulating Rod

Significant improvements were made to the regulating rod and its drive mechanism. The new rod is slightly larger (2-1/2" diameter vs 2-1/4" solid aluminum) to allow better reactivity control. A second motor and electric brake were installed in the drive to insure smoother and more reliable operation.

k. Operating Procedures

The operating procedures were rewritten to incorporate past changes and changes as a result system modifications and also to improve clarity. However, the changes in content were minor in nature.

l. Ultrasonic Tests of Primary Piping

All major primary piping and joints were utlrasonically tested to measure wall thickness and thus to detect any problems. None were detected.

m. Diaphragms

All diaphragms in the primary system valves were replaced.

7.8(3)(b) Unscheduled Shutdowns

1-14-84 Scram due to commercial electrical power dip. The reactor was returned to power at once.

4-03-84 Scram due to radio noise when two-way radio was operated in the vicinity of the conductivity rack gave a spike on a delta T channel. The reactor was returned to power and instructions were given to the staff not to use the radios in the area near the conductivity rack.

5-11-84 Scram due to commercial electrical power dip. The reactor was returned to power at once.

7.8(3)(c) Tabulation of Major Items of Plant Maintenance

1. Installed fourth main D_2O pump and associated piping and valves.
2. Replaced motors on three main D_2O pumps.
3. Replaced impellers on three main D_2O pumps.
4. Piped in HE-1B heat exchanger.
5. Removed main D_2O pump discharge check valves and installed a pump discharge valve operating system.
6. Removed the inner plenum check valve and the outer plenum check valve.
7. Replaced diaphragms in all D_2O valves.
8. Replaced air operator diaphragm in DWV-3.
9. Replaced internals of DWV-134 check valve.
10. Plugged 15 leaking tubes in HE-1A heat exchanger.
11. Replaced air regulator to DWV-3.

12. Cleaned secondary side of HE-1A, HE-2, and HE-6 heat exchangers.
13. Modified piping to the N-16 monitor.
14. Repaired SCV-5 air line.
15. Improved cooling tower makeup line.
16. Replaced bearings and seal on #2 secondary pump.
17. Installed additional shielding around primary IX columns #1 and 2.
18. Installed two new IX columns (#3 and #4) and connected them into the purification system for future use.
19. Removed a number of valves and automatic operators at the time of installation of new IX columns.
20. Replaced compressor on DWV-22.
21. Changed IX pre-filter.
22. Installed D_2O cooling lines to RT-1 and to future location of RT-2 rabbit tip.
23. Repaired tube leak in demineralized H_2O heat exchanger HE-7.
24. Replaced sleeve and seal in #2 demineralized H_2O pump.
25. Replaced wiring to #1 demineralized H_2O pump.
26. All coils in the upper header of the thermal shield cooling system were pressure tested several times in an effort to locate all possible leaks. Fourteen were detected and sealed.
27. Changed resin in #1 and #2 thermal shield IX columns.
28. Repiped the supply lines to the upper and lower headers of the thermal shield system.
29. Replaced the sleeve and seal assembly of the #1 thermal shield pump.

30. Installed a cross-connect in the refueling helium system.
31. Replaced the helium relief valve.
32. Modified controls on SF-19 and ACV-11 ventilation systems.
33. Replaced bearing assembly in the CO_2 purge fan.
34. Repaired SF-2.
35. Replaced battery room fan motor.
36. Replaced filters in hoods #1 and #6 in C002.
37. Replaced belt on #1 blower for RD3-4 and RD3-5.
38. Installed lagging on storage pool cooling system piping.
39. Installed new storage pool cleaning system.
40. Replaced the 3-way valve on the storage pool heat exchanger HE-8, with two valves.
41. Replaced storage pool pre-filters.
42. Cleaned storage pool IX flow distribution screens and replaced resin.
43. Cleaned check valve on the 1000 gal. Rad. Waste tank.
44. Replaced air solenoid to RWV-13.
45. Replaced the shield plug end of the BT-9 shutter.
46. Replaced the "O" rings in the RT-4 receiver.
47. Replaced the reg. rod with a 2-1/2" dia. x 29" rod.
48. Installed a new reg. rod drive with 2 motors instead of one and also an electrical brake.
49. Replaced float and repaired float switch on #1 sump pump.
50. Installed an emergency shower in secondary chemistry building.

51. Installed 3/4" air line in the Warm Shop.

52. Repaired truck door sealing surface.

53. Repaired sealing surfaces on all other confinement doors.

54. Repaired emergency cooling valve air regulator.

55. Replaced emergency pit sump pump.

56. Replaced ball-nut assembly on #1 shim arm drive.

57. Repaired zinc pump discharge line.

58. Repaired truck door air regulator.

59. Installed ladder and catwalk on HE-2.

60. Replaced inlet filters and housing on demineralizer.

61. Installed and calibrated 2 new secondary cooling flow transmitters FI-22 and FI-23.

62. Installed annunciator AN 3-16 for low pressure on valve operator reserve air tank.

63. Installed four 3-way switches on console for main pump discharge valves.

64. Installed four 4-way solenoid valves to operate pump discharge valves.

65. Installed four differential pressure switches to operate the pump discharge valves.

66. Replaced 2 radiation recorders with one programmable recorder.

67. Replaced and calibrated all secondary cooling system meters monitoring flow, temperature and level with horizontal meters.

68. Replaced and calibrated four primary system delta P transmitters with strain gauge type.

69. Installed 14 new RFI protected temperature transmitters.

70. Installed and calibrated two flow channels to monitor outlet flow from the two primary heat exchangers HE-1A and HE-1B.

71. Replaced and relocated TRCA-3 recorder/controller for primary inlet temperature.

72. Installed a 2-pen recorder (TR-4 and TR-5) to replace TIA-4 meter.

7.8(3)(d) Tabulation of Major Changes in the Facility and Procedures, and the Test and Experiments, Carried Out Without Prior Approval by the NRC pursuant to 10 CFR 50.59

All of the facility operating procedures are being reissued in order to put them on a word processor and to update them to incorporate the new modifications to the plant. These updates have not changed the concepts or principle of operation in any way.

Relevant Engineering Changes are summarized below and were also described in the summary of Plant Operations. Some of the changes were completed in 1985 but are included here for completeness.

ECN-278 Remove the check valves in the inner plenum line and the outer plenum line.

Like other large check valves, the performance of the two plena check valves has not been completely satisfactory. Their removal, therefore, will increase the reliability of the primary system by eliminating a potential source of failure that could introduce foreign objects into the primary system. The ability to control and deal with possible piping rupture is not

diminished since emergency cooling is always available regardless of the check valves. Furthermore, there are remotely operated diaphragm-type throttle valves in the same lines that could be used by the operator if needed.

ECN-276 Removal of the Main Pumps Discharge Check Valves.

These check valves have not performed satisfactorily over the years in spite of maintenance and replacement. Therefore, their removal improves the overall reliability of the system by eliminating the possibility of check valve wear that could result in the failure of the check valve to perform its function and/or check valve parts getting into the primary system. The functions of the check valves will be performed by the remotely operated diaphragm valves thereby considerably reducing the probability of failure.

ECN-272 Replace RT-1 and RT-2 pneumatic tube tips with shorter tips for use at 20 MW and add a D_2O moderating tank on the end of the new tips. This tank and the sample tip would be cooled by the D_2O experimental cooling system.

These new tips are shorter and therefore further away from the core than the ones they replaced. This will locate them in a superior flux and thermally cooler environment for sample irradiation. The remaining length will be replaced by a small D_2O tank to improve flux thermalization. The tips and tank will be cooled by lines from the existing reactor D_2O experimental cooling system which will provide ample cooling. The new tips will be of the same material and will be fabricated and tested in the same manner as similar reactor components.

ECN-287 Install 2 additional primary purification IX columns

The two new ion exchangers are identical in every respect to the existing ones.

ECN-286 Replace thermal shield supply and return headers with new lines outside the biological shield.

This is a simple bypass of embedded piping of a portion of the thermal shield cooling system. The new piping is of the same material. There is no change in operation or performance of the system. Radiation levels of external piping are low and comparable to existing piping.

ECN-283 Install an electric brake on the regulating rod.

This braking system prevents the reg. rod from slipping when the driving operation is stopped thereby providing smoother and more reliable operation without affecting the demand movement of the rod.

ECN-291 To modify the operation of the decontamination recirculating fan SF-19 and ACV-11 from automatic to manual.

This system is optional and there is no requirement for it. This change does not alter the ability to cleanup the Reactor Confinement Building but simply allows for evaluation before commencing cleanup operations. The great benefit of this change is that any possible local contamination will remain isolated and will not be automatically distributed throughout the Confinement Building. Other system components are unchanged.

ECN-292 Add a second motor in parallel to the reg. rod drive system.

Operation of two motors in parallel from the same source were bench tested with 150% normal load and all operations were similar. This change will allow smoother and more reliable operation of the drive mechanism.

ECN-293 Reg. Rod changed from 2-1/4" dia. to 2-1/2" dia.

The material of the two rods is the same, certified 6061 aluminum. The rod speeds are essentially the same. The 2-1/4" rod has a worth of about 0.6 dollars and the new 2-1/2" rod will have a worth of about 0.8 dollars. This new worth is well within acceptable limits of worth and will provide better reactivity control.

FCN-296 Relocate the Emergency Control Station to B-2 basement level

The new location allows greater and safer access and is more functional without affecting the operation of the Emergency Control systems in any way.

7.8(3)(e) Summary of Radioactive Material Released and Results of Environmental Surveys Performed.

The gaseous waste released was 767.6 curies of tritium and 274 curies of Argon-41, while 22.05 curies of tritium and 7.4 millicuries of other beta-gamma emitters were released into the sanitary sewer.

Environmental samples of the streams, wells, vegetation, and/or soil, and air showed no significant changes.

7.8(3)(f) Summary of Significant Exposures Received by Facility Personnel and Visitors

1. None to visitors.

2. Dosimetry results for this reporting period indicated that 15 operators received from 1.416 to 2.659 Rem.

UNITED STATES DEPARTMENT OF COMMERCE
National Bureau of Standards
Gaithersburg, Maryland 20899

April 3, 1985

U. S. Nuclear Regulatory Commission
Regional Administrator, Region 1
631 Park Avenue
King of Prussia, PA 19406

Subject: Docket #50-184

Gentlemen:

Transmitted herewith is Operations Report No. 37 for the National Bureau of Standards Reactor. The report covers the period January 1, 1984 to December 31, 1984.

Very truly yours,

Robert S. Carter

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Chief, Reactor Radiation Division

Attachment

cc: Director, Division of Reactor Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

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