

March 30, 2000

**Report on February 15, 2000  
Event at Indian Point 2**

**Introduction**

This report is submitted by the multi-agency team established by Governor Pataki to review the events leading to Con Edison's forced shutdown of its Indian Point 2 Nuclear Reactor in Buchanan, on February 15, 2000. The shutdown and emergency declaration of an alert resulted from a steam generator tube failure in one of the plant's four steam generators.<sup>1</sup>

The team consists of staff from the Department of Public Service (DPS), the Department of Health (DOH), and the State Emergency Management Office (SEMO). The purpose of this report is to present the team's findings on the event and provide recommendations.

This report addresses the following topics:

- ! Events leading to plant shutdown
- ! Plant operational response  
[analysis prepared by the  
Department of Public Service (DPS)]
- ! Public health and safety -  
radiological assessment [analysis  
prepared by the Department of  
Health (DOH)]

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<sup>1</sup> The steam generator tubes transfer heat from the nuclear reactor system to the non-nuclear portion of the power plant and, in the process, make steam that drives the electric generators. The failure described here occurred in generator number 24.

- ! Con Edison's communication response with state and local officials [analysis prepared by State Emergency Management Office (SEMO)]
- ! Further investigation planned by DPS Staff regarding:
  - Steam generator maintenance and inspection practices
  - Replacement of steam generators
  - Rate treatment of replacement power costs

### **Description of Events Leading to Shutdown**

On February 15, at 7:15 p.m., the radiation alarm in Indian Point 2's main steam line signaled increased radiation in the non-nuclear part of the plant, which is an indication of a tube leak. At 7:18 p.m., a radiation alarm in the steam jet air ejector exhaust line indicated a radiation release to the atmosphere that was well below technical specifications<sup>2</sup>. At 7:29 p.m., operators attempted to add additional water to the primary system to make up for the water that was leaking from the radioactive part of the plant to the non-radioactive part. When the pump was unable to keep up with the water loss, Con Edison shut down the reactor manually (Attachment 1 provides a detailed description of the sequence of events before and after the shutdown).

### **Plant's Operational Response**

Con Edison has demonstrated, to the satisfaction of the federal Nuclear Regulatory Commission (NRC), that the Indian

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<sup>2</sup> "Technical specifications" is the term given to Appendix A of each operating license issued by the NRC under 10 CFR 50. One section of that document provides limits on the amount of radiation that is permitted to be released. Routine releases below specified levels do not require off-site notification.

Point 2 nuclear power plant can be operated safely in the event of a steam generator tube leak with no off-site radiological consequences. Safety systems at Indian Point 2 are designed to handle the most severe steam generator tube failures. A leak like that which occurred on February 15, 2000 may not necessitate immediate action by the plant operator since it is well within the capability of the plant to safely shut down without a radioactive release that would pose a threat to public health and safety.

While the February 15 tube leak presented a challenge to plant safety systems and a breach of one out of three barriers designed to prevent the release of radioactivity, operators took immediate corrective action and limited the magnitude of any releases.

Staff from the Department of Public Service reviewed operator training and the response of the plant's operators to the event. Areas of investigation included:

- ! whether operators responded properly to information that a minor leak had developed and was increasing in intensity prior to the event;
- ! whether operators followed prescribed procedures in reacting to the event; and
- ! whether all equipment performed as designed during the event.

Generally, the plant's operators appear to have taken the proper actions during and after the event, in accordance with established procedures for abnormal and emergency conditions<sup>3</sup> with some exceptions, as noted below. Prior to the event, plant management cautioned operators to be aware of the increasing leak

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<sup>3</sup> The procedures are set forth in various manuals developed by nuclear operators and the designers and manufacturers of the plant systems and equipment.

rate and the potential for a tube rupture and emergency shutdown. The Nuclear Regulatory Commission's (NRC) resident inspector also briefed his supervisors regarding the tube leak situation. Neither plant management nor the NRC determined that a plant shutdown was necessary at that time.

When the tube ruptured, operators followed the prescribed procedures, resulting in a manual shutdown of the plant. Reactor shutdown occurred as procedures dictated and the plant responded as it had been designed to do.

Con Edison encountered difficulties after shutdown during the plant cooldown process. These difficulties included the inability to control steam flow to the condenser, poor condenser vacuum control, and a slow plant cooldown rate.

! Steam dump valves are used to send steam from the generators to the condenser to remove energy from the primary system. The steam dump valve control system is difficult to operate and resulted in more steam being released than the condenser could handle. The control problems resulted in the partial loss of vacuum in the condenser.<sup>4</sup>

! Steam jet air ejectors are used to control condenser vacuum during operation and shutdown. Operating steam to the air ejectors is to be controlled automatically by a regulator. Apparently, the automatic function had not operated properly for many years.

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<sup>4</sup> A vacuum in the condenser allows more work to be done by the turbine, increasing its efficiency. Condenser vacuum is maintained by continuously removing any air and non-condensable gas via air ejectors. The air ejector exhaust is normally discharged to the atmosphere and usually contains little, if any, radioactivity. If radioactivity is detected, the air ejector discharge is routed to the containment area, preventing a release.

! During the cooldown process, there was a delay of over five hours in placing the residual heat removal system in service because of discrepancies in the procedures. Operators recognized the problem and resolved it. However, this discrepancy in the procedures extended the amount of time the plant was in cooldown, which, in turn, kept the plant in the emergency condition for longer than necessary.

#### Recommendations

1. Con Edison should correct equipment deficiencies on a priority basis and in a timely manner. A listing of known equipment deficiencies and a plan for resolution must be provided to DPS staff prior to restart.
2. Con Edison should thoroughly review the procedures for placing the residual heat removal system into service and correct any deficiencies prior to restart of the plant.

#### **Public Health and Safety - DOH Radiological Assessment**

To assess the public health impact of the event at Indian Point 2, DOH staff reviewed available radiological information, focusing on the following topics:

- ! Identification of release pathways, including their location, duration, and magnitude; and
- ! Assessment of off-site radiation measurements.

#### Identification of Release Pathways

There were several release pathways during this event. DOH reviewed the calculations performed by Con Edison that show actual and projected maximum releases from all possible pathways resulting from the event ("event-related" and "post-event-related" releases). Since the releases from this event were too small to be measurable at the site boundary, Con Edison also included potential releases in the calculation. Both types of

releases were separated into gaseous or liquid effluents. Review of the data shows that the total dose from all the gaseous and liquid releases, during and after the event (0.01 mrem), is a small fraction of annual natural background radiation (300 mrem).

Two post-event liquid releases to the Hudson River resulting from radiologically contaminated liquids that had gone for treatment at the Unit 1 waste treatment area did not exceed the permit limits. The doses from these releases resulted in a release of a small fraction of normal background radiation.

#### Assessment of Environmental Radiation Measurements Off-Site

DOH staff took soil and snow samples at six locations around the plant on February 17 and 18. NRC staff took two additional soil samples just outside the north and south boundaries of the plant property on February 16 and gave part of the samples to the DOH. The DOH samples did not show radioactivity above normal background levels.

Con Edison air samples taken at fixed locations both on-site and off-site showed no elevated readings. Direct radiation readings made by Con Edison showed the same thing. In addition, partial data from fixed radiation monitors around the plant showed no elevated radiation readings. However, half of the fixed radiation monitors did not communicate with the control room automatically (as designed). Instead, the data had to be manually retrieved by phone. It was recently learned that two of the monitors had additional problems and did not function properly. Con Edison is investigating this further. It should be noted that Con Edison field personnel with portable monitors in the same general area did not detect any radiation above background levels, a finding which has been confirmed by the Department of Health.

Laboratory analysis results of samples collected by Con Edison at several locations both on-site and off-site show no radioactivity above normal background levels.

Finally, air sampling and field measurements conducted by Westchester County staff at several locations during the night on February 15 indicated no elevated readings.

#### Findings

County and state agencies rely on the information provided by the fixed radiation monitors located around the plant. However, information from these monitors was not readily available during the event. Con Edison has developed some "work around" procedures to retrieve data from the off-site Reuter-Stokes monitors. Data transmission and other problems with the off-site Reuter-Stokes monitors need to be addressed promptly since they are a source of data for off-site agencies.

Gases and liquids containing trace amounts of radioactive materials were released to the environment as a result of this incident. The dose resulting from all releases is estimated to be 0.01 mrem, which is about 0.003% of the annual dosage received from natural background.

The Department of Health concludes that this incident did not pose a threat to public health.

#### Recommendation

3. Con Edison must address the lack of information available from the fixed radiation monitors (Reuter/Stokes) during the event and indicate how it plans to maintain the radiation monitors in an operable condition on a continuous basis. This information should be provided to DPS and DOH staff prior to startup.

#### **Communication with State and Local Officials**

Nuclear power plant emergency planning requirements are promulgated by the Federal Government. The state and county (Westchester, Rockland, Orange, and Putnam) radiological emergency response plans for the Indian Point site have been approved by the Federal Emergency Management Agency (FEMA). Utility emergency plans are reviewed and approved by the Nuclear Regulatory Commission (NRC).

New York State, the affected counties, and the nuclear utilities in New York State use a common form to relay emergency information from a nuclear power plant to the off-site emergency response organizations. This form is designated as the Radiological Emergency Data Form, Part 1.

Con Edison's emergency plan for the Indian Point Unit 2 facility requires control room operators to use this form to notify off-site officials following an emergency declaration. NRC rules require that the utility notify off-site organizations within 15 minutes from the time that the declaration is made. The information from the form is transmitted via the Radiological Emergency Communications System (RECS), a system of dedicated phones linking the nuclear power plant control room with various off-site locations.

Plant control room personnel issued the initial notification of the alert declaration, via the RECS, at 7:41 p.m. Con Edison subsequently transmitted forty messages regarding the incident, ending at 6:53 p.m. on Wednesday, February 16, 2000. No message was received between 8:29 p.m. and 9:30 p.m. on February 15. This lapse in reporting created a problem for the off-site agencies and their evaluation of the event. A subsequent message also exceeded the time requirements specified in Con Edison's procedures.

Early in the incident, information contained on the Radiological Emergency Data Form, Part 1 (especially Item 8 - Brief Event Description) was insufficient to describe the event accurately to off-site officials. The callback number (item 14) on the Radiological Emergency Data Form, Part 1, was a number for the power plant control room; personnel were not available at that number to answer follow-up questions from state DOH personnel. Furthermore, the referenced phone number was not changed following activation of the utility's Emergency Operating Facility, a site away from the control center set up for directing emergency activities.

#### Recommendations

4. State agencies, affected counties, and the nuclear facility operators should re-examine the Radiological Emergency Data Form, Part 1 and revise the form to ensure that it will include all information needed by off-site officials to respond to an emergency originating at a nuclear power plant.
5. Con Edison officials at Indian Point Unit 2 should review and update emergency procedures to prevent lapses in the report/update times.
6. Con Edison must address emergency staffing requirements to ensure that an adequate number of staff is available during an incident to provide relevant, timely information, and answers to off-site officials.

#### Activation of Con Edison's Emergency Operating Facility

Con Edison's emergency plan for Indian Point Unit 2 dictates that the utility's Emergency Operating Facility (EOF) is to be activated following an alert declaration and an emergency director should be designated. Con Edison activated the EOF at 9:17 p.m. on February 15. However, a contact number for the EOF was not identified on the Radiological Emergency Data Form, Part 1.

The Meteorological Information Data Acquisition System (MIDAS), which is designed to provide off-site radiological and meteorological information to off-site officials, was not consistently available during the event.

Furthermore, there were no technical liaisons to work with the state and local liaisons assigned to the EOF. The Emergency Data Display System (EDDS), which provides plant data, failed several times. Overall, the information available to state and county staff from the EOF was inadequate.

#### Recommendations

7. Con Edison should review the operational procedures for the EOF to ensure that the

emergency director initiates and maintains contact with off-site officials.

8. Con Edison should review the operational procedures for the EOF to ensure that technical specialists are assigned to work with state and local liaisons assigned to the facility.
9. The MIDAS system should be fixed so that it is operational at all times.
10. Con Edison should upgrade the EOF to include digital displays of plant conditions and parameters for the state and local liaisons.
11. Con Edison should review the operational procedures for the EOF to ensure that off-site organizations will be made aware in a timely manner that the EOF has been activated.

#### Activation of Joint News Center

The Joint News Center (JNC) for the Indian Point site is located at the Westchester County Airport. The JNC is intended to provide a fixed location to brief the media, use the Emergency Alert System to disseminate protective action recommendations to the general public<sup>5</sup>, and conduct media monitoring and rumor control operations.

During the event, personnel did not arrive to staff the JNC facility until approximately 10:00 p.m on February 15. Furthermore, the utility did not provide the required security and clerical support for the efficient operation of the facility. County officials reported that the media contacted county EOCs to gain information. This has raised concerns about the role and function of the Joint News Center.

Con Edison and Westchester, Rockland, and Putnam counties conducted the first media briefing at the JNC at 11:45 p.m. Prior to this briefing, Con Edison had responded to media calls and provided the media with details on plant conditions and

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<sup>5</sup> The Emergency Alert sirens were not activated for this event.

the utility response. Subsequent media briefings occurred on February 16 at 2:00 a.m., 5:45 a.m., 1:15 p.m., and 7:00 p.m.

Concurrent with the media briefings, the JNC personnel conducted rumor control operations (i.e., answering telephone inquiries from the general public and media). The rumor control function became operational at approximately 11:30 p.m. and continued to respond to calls until the JNC stopped operations on the evening of February 16. Con Edison operators handled more than 900 calls during the event.

Courtesy notifications between the utility public information staff and the SEMO public information officer must occur regularly. This is a method for sharing information between the utility and the state headquarters prior to the opening of the JNC. On February 15, this did not occur, creating media confusion regarding the facts about any radioactive releases.

Technological enhancements can address some of the problems that occurred early in the event. For example, video and teleconferencing could enable counties and the state to share information so that the normal delays in opening the JNC do not impede communications.

#### Recommendation

12. County and state officials should examine technology enhancements to improve communication of plant information during emergency events and report their recommendations by October 1, 2000.

#### Information About the Release of Radiation

None of the Radiological Data Forms, Part 1, supplied by the utility to off-site officials, indicated that there was any release of radioactive materials from the plant. Item 6 on the form was designated as "No Release Above Technical Specifications".

During the event, a Con Edison spokesman reported to the media that a radioactive release had occurred. While the release was greater than zero it was below the technical

specifications for the plant. Releases below these technical specifications do not require off-site notifications. The spokesman provided information to the media before discussing it with the off-site organizations, creating significant public perception and credibility problems. The information about radioactive releases should have been reported to state and local officials prior to reporting them to the media. In the future, when a radioactive release occurs, Con Edison should ensure that information is provided to state and county representatives prior to discussions with the media. This is important since these officials need time to formulate protective actions that may be needed to protect health and safety.

#### Recommendation

13. Con Edison should ensure that information is provided to state and county representatives prior to discussions with the media.

#### **Status of DPS Staff Investigation**

In addition to analysis of operator response to the event, Staff of the Department of Public Service has responsibility for reviewing the circumstances surrounding the February 15, 2000 steam generator tube failure at Indian Point 2. Staff's efforts have focused on NRC and company actions with regard to the steam generator inspection methodology and adequacy, root-cause analysis of the February tube failure, and plans to repair or replace the generators.

#### Recent NRC Developments

In late February, the NRC asked its Office of Nuclear Regulatory Research to review the safety evaluations that had been performed in 1999 by Con Edison and its own Office of Nuclear Reactor Regulation regarding the safe operation of the Indian Point 2 steam generators. One of these reviews centered on the reasonableness of Con Edison's request for an extension (from June 1999 to June 2000) of the steam generator tube inspection interval beyond that required by the plant's technical

specifications. The NRC granted a one-time extension in June 1999.

The research arm of the NRC has recently concluded that, based on the most recent inspection of the steam generator tubes, Con Edison's assessment of two forms of tube degradation were weak, incomplete, and inadequate. Using this inadequate information, the NRC granted the extension of the inspection interval.

Specifically, the NRC asked Con Edison to provide additional information to assure the NRC of the structural integrity of all steam generator tubes. The NRC asked Con Edison to provide an explanation of the predictive methodology, tube crack growth rates, and the inherent uncertainty of inspection methods used. Although it appears that NRC staff asked for the information necessary to determine whether Con Edison's assessment of the steam generator tubes was sound, the NRC has now determined that the Con Edison response was inadequate and that the NRC staff accepted the inadequate response without further inquiry or analysis. The NRC lessons-learned assessment should address the apparent process weakness that allowed an inadequate and incomplete response to safety issues to be accepted and become the basis for an NRC decision. Con Edison's failure to thoroughly assess steam generator tube degradation and provide the NRC with clear and complete information may be symptomatic of more widespread problems.

Before the NRC determines whether Indian Point 2 is safe to restart, the NRC staff will review the results of Con Edison's current and previous steam generator inspections, perform root-cause evaluation of the steam generator tube failures, and implement proposed corrective actions. Corrective actions are likely to include more frequent inspection of steam generator tubes and operator actions.

The NRC has stated that its decision on whether the Indian Point steam generators are safe to operate will hinge on the report Con Edison submits dealing with the issues described

above, especially the root-cause evaluation and proposed corrective actions. The NRC is unable to estimate when it will make this determination.

Con Edison expected that steam generator inspections and analysis would be completed by the end of March 2000. However, Con Edison has decided to expand the scope of testing of the steam generator tubes and the time needed to complete its analysis. Due to this expanded work scope, Con Edison has decided to start its refuelling outage concurrent with these activities. Staff of the Department of Public Service is monitoring the plant restart process.

### **Next Steps**

The Department of Public Service will institute a proceeding to continue its review of the reasonableness of Con Edison's operational and communications response to the event and assess the circumstances surrounding the event to determine whether the February 15, 2000 outage should have been avoided. This proceeding will include the following components:

- ! Review the causes of the outage, including events preceding the outage
- ! Determine whether Con Edison's steam generator inspection and maintenance practices were reasonable
- ! Assess whether the company's decision to postpone the replacement of the steam generators was prudent
- ! Determine whether, and to what extent, replacement power costs and other costs should not be charged to ratepayers

Inherent in the Commission's ratemaking power is the ability to order refunds of charges. The Commission will decide

whether disallowance of any costs associated with this incident is warranted.

SEMO will work with Con Edison, the other nuclear utilities, and the affected counties to further define emergency plans and procedures to improve off-site notification. SEMO will develop a list of "lessons-learned" covering emergency planning issues associated with this event and a time line for corrective action.

SEQUENCE OF EVENTS  
 INDIAN POINT NUCLEAR STATION  
 UNIT 2  
 FEBRUARY 15, 2000  
 EMERGENCY - ALERT

February 15, 2000

|       |   |
|-------|---|
| 1900  | Reactor Power 99%   |
|       | Gross Electrical Load 1003 MWe  |
| 1915  | #24 Steam generator leak rate 3.4 gallon/day  |
| 1915  | Radiation alarm in main steam line  |
| 1917  | Pressurizer level starts to decrease and charging pump flow began to increase                   |
| 1918  | Radiation alarm in steam jet air ejector flow path  |
| 1919  | Second charging pump started  |
| 1922  | Steam generator blow down showed upward trend in radiation reading                              |
| 1929  | Reactor coolant system inventory loss greater than capacity of two charging pumps               |
| 1929  | Reactor manually tripped  |
| 1929  | Declared ALERT, Emergency Action Level 3.1.2  |
| 1930  | Main generator trip   |
| 1931  | Sounded emergency alarm   |
| 1932  | On-site announcement of emergency and to report to assembly areas                               |
| 1933  | Con Ed Central Information Group notified   |
| 1939  | Central control room notified security  |
| 1940  | Central Information Group called back to verify call  |
| 1941  | Initial RECS notification to NYS and local counties   |
| 1952  | Notified Indian Point 3   |
| 2000  | Majority of Emergency Response Organization pagers sounded                                      |
| ~2000 | State of New York rep called EOF for information; placed on hold for 45 minutes                 |
| ~2000 | Security closed and guarded main gate   |
| ~2000 | Joint News Center responders did not have keys to open up                                       |
| 2005  | Notified NRC Resident Inspector   |
| 2008  | Notified NRC via ENS  |
| 2012  | Auxiliary Feedwater flow reestablished to #24 Steam Generator                                   |
| 2018  | Continued uncontrolled increase in level in #24 Steam Generator                                 |
| 2018  | Initiated isolation of #24 Steam Generator  |
| 2028  | Auxiliary Feedwater flow secured and # 24 Steam Generator isolated                              |
| 2029  | Rough leak rate determination at about 90 GPM   |
| 2029  | Directed to add 700 gal boron   |
| 2029  | Power Operated Relief Valve lifted at 1020 psig - reset at approx. 1008 psig - open 23 minutes. |
| 2031  | Main Steam Valve for #24 Steam Generator closed   |
| 2045  | Accountability reported to control room as complete   |
| 2103  | Reactor coolant system temperature 530 deg. F.,   |

pressure 2000 psi.  
2104 Inserted manual safety injection to compensate for  
rapid pressurizer level drop  
2108 Commenced rapid cooldown and depressurization to  
minimize inventory loss of primary coolant  
2108 Safety injection automatically initiated  
2113 #24 Atmospheric dump valve reset at 1008 psig  
2115 Plant re-pressurized above 1500 psi and safety  
injection flow stopped  
2115 Emergency Operations Facility activated  
2147 Second accountability complete - four missing  
persons  
2202 First News Release - Any radioactive releases would  
be a small fraction of the EPA Protective Action  
Guidelines  
2217 Accounted for four missing persons  
2219 Emergency Response Data System failed  
2252 Plant Stabilized - Entered "Post Steam Generator  
Tube Rupture Recovery - Backfill" procedure  
2255 Field teams all reading background levels  
2310 No radiation readings by field teams

February 16, 2000

0500 Reactor coolant system at 353 deg. F. and pressure  
535 psig  
0720 Condenser vacuum pump tripped  
0852 Restarted vacuum pump  
0912 Obtained Westinghouse approval for emergency  
procedure change for putting residual heat removal  
system in service  
0936 Containment entry complete  
1234 Residual heat removal system put in service  
1330 Reactor coolant system temperature at 280 deg. F.  
and pressure 356 psig  
1657 Unit achieved cold shutdown (below 200 deg. F.)  
1850 Terminated Alert status