

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

Indian Point Unit No. 2

AEC Docket No. 50-247

Investigation and Consequences of a
Steam Generator Nozzle Debris Plug Assembly
Being Inadvertently Left In-Place During Operation
of the Reactor Coolant System

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Introduction

Upon removal of the upper internals package, on the evening of Monday, September 11, 1972, preparatory to defueling the Unit No. 2 reactor, a crumpled piece of stainless steel was found in the lower flange plate of the upper internals package in front of the reactor outlet nozzle to No. 22 steam generator. The crumpled piece of stainless steel was the center piece of a three-piece assembly that had been used to cover the reactor coolant piping nozzles in the steam generators. These assemblies had been placed in the piping nozzles on all four steam generators of Unit No. 2 during inspections made May through July, 1972.

Following the inspections, the Reactor Cooling System was closed with this one plug assembly in the hot leg of Loop 22. Subsequently, a hydrostatic test of the Reactor Coolant System was performed. This test required operation of reactor coolant pumps and the resultant flow in the Reactor Coolant System apparently dislodged the plug.

Description of Events

The three-piece plate assembly was one of four similar assemblies, one for each of the four steam generators. The plate assembly is made in three sections in order to allow it to be passed into the steam generator via the small manway. It is assembled in place and put over the reactor coolant piping nozzle, after which it is taped down to the interior of the waterbox of the steam generator. The purpose of this plate is to prevent foreign objects from falling into the reactor coolant piping while work is going on in that waterbox.

This plate assembly consists of a quasi-rectangular 16-gauge stainless steel plate, fourteen by thirty-eight inches, and two half moon sections of 16 gauge stainless steel plate. The three pieces are bolted together with eight welded cap screws (attached to the half moon sections) and eight wing nuts to form a circular plate assembly thirty-six inches in diameter. The quasi-rectangular piece was the one found in the upper internals package.

On September 14, 1972 the manway cover of the No. 22 steam generator inlet waterbox was removed. An inspection inside the waterbox revealed the other two sections (i.e., the two half moon sections) of the assembly. All eight of the welded cap screws had been sheared off. The heads and a part of the cap screws were still welded to the half moon sections. During this and subsequent inspections, all but one wing nut and one cap screw piece (approximately 1/4 inch x 3/4 inch) were found and removed. Further inspections are being undertaken to locate these two pieces. The yellow tape used to tape the three-piece assembly to the reactor outlet nozzle in the waterbox of the steam generator, has been found in various parts of the Reactor Coolant System.

The steam generator inlet waterbox tube sheet and tube ends were preliminarily inspected and minor scoring of some tube ends was noted. No damage was found on the tube sheet.

An inspection of the upper core package revealed no damage.

An inspection of the primary coolant pipe from the reactor vessel to the waterbox of No. 22 steam generator was conducted by the Operations Engineer for Unit No. 2 on June 20, 1972. During that inspection, the plate covering the steam generator inlet nozzle was in place and the Operations Engineer was therefore unable to enter the steam generator. Two Quality Control Inspectors on July 5, 1972 using a rope ladder attached to a support frame outside the manway entry into the inlet and the outlet waterboxes of No. 22 steam generator, entered the steam generator. They inspected and cleaned the lines and the waterbox up to the reactor vessel from the reactor side of the steam generator, and to the primary coolant pump from the steam generator outlet side of the steam generator. Upon completion of this inspection, a fifty-three pound stainless steel gasket insert plate was installed in the manway opening to the steam generator inlet and outlet boxes and each was held in place with three machine screws. On July 6, 1972, the Quality Assurance Engineer and a Unit No. 2 Watch Foreman performed the final close-out inspection on both waterboxes of No. 22 steam generator. Neither man completely entered either of the waterboxes, but each of them individually put their head and shoulders inside the waterbox and made an inspection with the aid of a light. They reported each waterbox to be clean and completely clear of all foreign material and authorized re-installation of the manway cover. Prior to re-installing the manway cover, a new flexatallic gasket and the stainless steel insert plate was attached to each manway opening with three machine screws. The insert plates and new gaskets were personally installed by the Watch Foreman in the presence of the Quality Assurance Engineer immediately following their inspection. The manway covers were installed on No. 22 steam generator on July 6 and 7, 1972.

Based upon the above, the most probable cause of leaving the plate assembly in the Reactor Coolant System during the hydrostatic test is as follows:

The inspection of the interior of the steam generator waterboxes and lines using the rope ladder on July 5 and the close-out inspection by the Quality Assurance Engineer and Watch Foreman on July 6 was not actually made on the boiler inlet side of No. 22 steam generator. It is concluded that they inspected the same steam generator and/or waterbox twice. Since Nos. 23 and 24 steam generator waterboxes were still open, that is to say, the manway covers were not yet installed on July 5 and 6, it is possible that Nos. 23 or 24 was actually the steam generator inspected by one team in one case on July 5, and by the other team in the other case on July 6.

Corrective Action

In order to assure that a similar occurrence is precluded in the future, the following changes were immediately implemented. Each Quality Control Inspector is now required to keep on his person, while employed as an inspector, a diary in which he will record as the inspection process proceeds, details of his observations. Later consolidation of these details

are recorded in the Quality Assurance Engineer's log at the end of his watch. In addition to existing inventory procedures, each steam generator waterbox manway access is to be labeled and color coded as to which steam generator, and which waterbox, whether inlet or outlet, it provides access to. New and separate entry permits for each opening and closure into any component are now required. For example, if work inside a component is intermittent and the component is temporarily closed, that permit must be closed out at that time and a new permit issued to re-open it to complete the work. Sufficient Quality Assurance manning will be provided to insure total coverage during the time that the component is open. If a Quality Control Inspector is not available at any time, then access to that component will be denied. Lock wire and a lead seal shall be used on a temporary closure at the end of each shift or whenever work is interrupted and/or a Quality Control Inspector is not available at the job site. A mandatory final review of all opening permits, closing permits and inventory sheets will be made prior to final closure. Defects in that review will be noted, and a search made to correct such defects before final closure is authorized. Quality Control in Nuclear Power Generation will establish a Pipe Plug Log for all temporary pipe plugs where the interior of a component has a pipe plug installed. A tag clearly indicating this fact will be attached to the external portion of that component. The Pipe Plug Log will be one of the documents reviewed and satisfied prior to final closure of the component. The Watch Foreman will make a final inspection with a Quality Control Inspector as the final closeout inspection, as part of the work permit completion.

Safety Implications

Had this condition remained undetected prior to operation, it would not have adversely affected the safety of the plant. Continued Reactor Coolant System operation with the plate present in a hot leg of the system could eventually have resulted in steam generator leakage. Such leakage would have immediately been detected, and the plant would have been shut down and the condition corrected. The reactor and reactor coolant system geometry is such that the plate left in the hot leg could not have caused any core flow blockage. While it is conceivable that a wing nut or cap screw piece or a corner of a plate could have caused control rod sticking, this is considered unlikely due to the geometry of the upper internals. The plant, however, is designed and operated such that it is capable of being shut down at any time with the most reactive rod stuck fully out.

Hence, it is concluded that had the assembly been inadvertently left in the Reactor Coolant System, and had the reactor been operated, there would not have been a significant safety problem. Nonetheless, the previously described corrective actions are being taken to preclude such an incident occurring again. In addition, it should be noted that Con Edison is engaged, with Westinghouse, in a development program for a loose parts monitoring system. Prior to the discovery of the plate, plans had already been made to take measurements with the developmental system prior to initial criticality. Data obtained to date from the developmental system indicate that this system would have detected the presence of the plate. It is Con Edison's intent to proceed with the development work on a loose parts detection system. The development work will include in-plant measurements during plant startup.