1.0 INTRODUCTION

1.1 Background and Purpose

The Nuclear Regulatory Commission (NRC), in a letter dated May 11, 1976, requested that Metropolitan Edison Company conduct an examination of the Three Mile Island Nuclear Station Unit 1 (TMI-1). The purpose of the investigation was to compare existing fire protection provisions with the guidelines presented in Standard Review Plan (SRP) 9.5.1, "Fire Protection", dated May 1, 1976, which includes Branch Technical Position APCSB 9.5-1. Metropolitan Edison was specifically requested to:

a. Identify and discuss those guidelines, which are satisfied.

b. Identify those guidelines for which modifications, procedural changes, or enhanced training of personnel are required, indicating those that are being developed or planned.

c. Identify those guidelines, which are not satisfied and provide a basis of justification for this position.

In a subsequent letter dated September 30, 1976, the NRC transmitted Appendix A to APCSB 9.5-1, which provides certain acceptable alternatives to the positions given in APCSB 9.5-1 for plants already in operation. Therefore, an evaluation was performed and the point-by-point comparisons were made with respect to those guidelines in Appendix A identified as applicable to "plants under construction or operating plants." In addition, the NRC stressed that for purposes of evaluation, a fire hazards analysis must be performed to the level of detail indicated by Enclosure 2 to the NRC's letter, "Supplementary Guidance on Information Needed for Fire Protection Program Evaluation." It was requested that the analysis be conducted under the technical direction of a qualified fire protection engineer. In addition to the fire hazards analysis, proposed technical specifications for the existing fire protection systems were requested to be submitted. These were transmitted by Metropolitan Edison to the NRC on February 10, 1977.

On November 19, 1980, the Nuclear Regulatory Commission issued Appendix R to 10CFR50 entitled "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979", thus clarifying its regulations which require certain provisions for fire protection in operating nuclear power plants, in particular, those provisions which a nuclear plant must incorporate to retain the capability to safely shutdown the reactor in the event of fire. This action was taken to upgrade nuclear power plant fire protection features by requiring resolution of contested generic issues in fire protection safety evaluation reports.

Appendix A to Branch Technical Position APCSB 9.5-1 had been the basic fire protection guidance used by the staff in their fire protection reviews conducted for all operating plants. The iterations of SER supplements No. 1 thru 5 to the NRC Staff's evaluation of the initial TMI-1 Fire Hazards Analysis Report dated May 15, 1977 indicated that there were requirements in Sections III.G, J., and O. of 10CFR50 Appendix R in which the protection afforded by Appendix R was over and above that previously addressed.

Section III.G. of Appendix R addresses Safe Shutdown Capabilities and Alternate Shutdown and gives a discussion between the requirements for safety related equipment and that needed for safe shutdown. In particular, Section III.G. relates to fire protection features for insuring that systems used to achieve and maintain safe shutdown are free from fire damage.

For the 1982 submittal of the Fire Hazards Analysis Report, EDS Nuclear, Inc., Melville, New York assisted General Public Utilities Nuclear Corp. (GPUN) in the performance of an Appendix R evaluation and a Plant Fire Hazards Analysis Update.

This submittal, dated July 1, 1982 included 14 exemption requests to the technical requirements of 10CFR50, Appendix R, Section III.G. The NRC staff's safety evaluation of June 4, 1984 addressed the submittal and granted 13 exemptions (one having been subsequently withdrawn) as well as the alternate shutdown capability. The granted exemptions were contingent upon administrative control of transient combustibles equivalent to that specified in Section III.K.1 through .8 of 10CFR50 Appendix R. Several issues were identified in the 1984 SER, which required additional resolution.

To supplement the 1982 Fire Hazard Analysis Report, GPUN retained Gilbert/Commonwealth, Inc. to perform an in-depth reevaluation of the components and circuits required for the safe shutdown. The purpose of the reevaluation was to demonstrate that the fire protection programs (existing and revised) at Three Mile Island Nuclear Station Unit 1 (TMI-1) would prevent damage to at least one train of equipment necessary to achieve hot shutdown and would protect or limit the damage to the equipment necessary to achieve cold shutdown so that at least one train can be repaired within 72-hours using onsite capabilities, in the event of fire in any one fire area/zone of the plant. Gilbert/Commonwealth, Inc. documented the results of this reevaluation in G/C report 2586. The analysis contained in this document is not maintained current and therefore may be regarded only as a historical reference. Therefore, any information in this reevaluation should be verified against the current FHAR revision or other current configuration controlled design document before using.

After several iterations the Fire Hazards Analysis Report and Appendix R Section III.G safe shutdown analysis (FHAR), Revision 7 was submitted on November 7, 1985. This submittal included information in support of items requiring additional resolution from the 1984 SER and additional exemption requests to the technical requirements of 10CRF50, Appendix R. The NRC staff's safety evaluation of December 30, 1986 addressed the submittal as well as GPUN correspondence of October 30, 1984,

February 11, 1985, November 7, 1985, May 17, 1986, July 22, 1986, August 19, 1986, October 22, 1986, November 19, 1986, and November 20, 1986. The staff's evaluation closed the two issues that were previously unresolved and granted a number of additional exemptions. However, based on the need for additional information, the SER denied exemptions for certain manual actions associated with valve alignments, control of pumps and loss of ventilation systems. Alternate shutdown capability was considered an open item. Associated circuits were an unresolved issue.

On March 3, 1987 GPUN submitted FHAR, Revision 8, based on plant design as of January 1, 1987 to the NRC. This document was supplemented by GPUN letters dated January 13, 26, 29, 1987 and February 2, 10, 11, 28, 1987 submitted to the NRC.

The purpose of revision 8 of the 1982 Fire Hazards Analysis Report was to present the "as designed" results of the fire protection program evaluation, including an update of the initial TMI-1 Plant Fire Hazards Analysis dated May 15, 1977 (Gilbert Associates, Inc. Report No. 1938), and 1982 Fire Hazards Report in accordance with the aforementioned NRC requirements. This report also documented the results of an Appendix R reevaluation which evaluates TMI-1 fire protection features against the requirements of Section III.G. of Appendix R, including other sections of Appendix R that are referenced in III.G.

By letter dated March 19, 1987 the NRC addressed all previously unaccepted exemptions and new exemptions identified to date. These were all accepted. Alternate shutdown capability remained open and associated circuits remained unresolved, pending NRC review of GPUN correspondence via letter 5211-87-2070, dated March 20, 1987 and 5211-87-2028, dated February 10, 1987.

On October 27, 1987 GPUN submitted FHAR, Revision 9, based on the "as built" condition of TMI-1 and incorporating pertinent information identified in GPUN letters submitted to NRC supplemental to Revision 8.

Revision 10 of the Fire Hazards Analysis Report represents continuing changes to plant design and fire hazards analyses as of March 31, 1988. This revision also includes the extension of 20 minute roving fire watch to FH-FZ-6 per GPUN letter 5211-87-2175 dated October 16, 1987 and the new neutron flux monitoring system (R.G. 1.97) per GPUN letter 5211-87-2214 dated November 18, 1987. Alternate shutdown capability remains an open issue and associated circuits remains an unresolved issue, pending NRC review of GPUN correspondence via letter 5211-87-2070 dated March 20, 1987 and 5211-87-2028 dated February 10, 1987.

Revision 11 represents continuing changes to plant design and fire hazards analyses as of March 31, 1989. This revision includes the elimination of exemptions for HVAC in Control Building, EFW Pump Rooms, Diesel Generator Rooms and Nuclear Services Pump Room as documented in NRC letter dated September 7, 1988 (SER). In addition, additional approved exemptions and manual actions per GPUN letter C311-88-2057 are included as approved via NRC letter dated February 2, 1988. This revision now includes manual actions associated with Alternate Shutdown for internal use and programmatic considerations and reflects License Amendment 146 regarding deletion of Fire Protection Technical Specifications. Alternate shutdown capability remains an open issue and associated circuits remains an unresolved issue pending review of GPUN correspondence.

Revision 12 represents continuing changes to plant design and fire hazards analyses as of April 30, 1990. This revision includes physical changes to the Control Room, removal of walls at H&V rooms, and Reactor Coolant Pumps Lube Oil System upgrade including exemption per GPUN letter C311-89-2120 as approved via NRC letter dated February 26, 1990. Alternate shutdown capability remains an open issue and associated circuits remains unresolved as discussed in NRC letter dated October 19, 1989.

Revision 13 represents continuing changes to plant design and fire hazards analyses as of April 15, 1991. This revision includes a revised description of fire pump arrangement with the diesel driven fire pump in the TMI-2 River Water Pump House now used for emergency backup only, thermal fire detection in the Reactor Building, and additional detection in the Turbine Building Switchgear area. It also includes a non-fire service use of the fire protection system for an additional diesel generator. Alternate shutdown capability remains an open issue and associated circuits remains unresolved as discussed in NRC letter dated October 19, 1989.

Revision 14 represents continuing changes to plant design and fire hazards analysis as of May 20, 1992, and reflects the closing of the former associated circuits unresolved issue per Section 7.1 of NRC Inspection Report 50-289/90-20 (GPUN assigned letter No. C-311-91-3003).

Revisions 15 and 16 represent continuing changes to plant design and fire hazards analysis as of February 1, 1996. Revision 16 adds new fire areas for outlying facilities that were part of TMI-2 and are now operated by TMI-1.

Revision 17 represents continuing changes to plant design and fire hazards analysis as of February 1, 1998. This revision includes the addition of a new instrument shop and office facilities in the “Control Building Patio” area. The Technical Support Center has been moved to elevation 355’ in the Control Building.

Revision 18 represents continuing changes in plant design and fire hazards analysis as of March 1, 2000. This revision includes the plant changes made to resolve Thermo Lag fire barrier qualification and implements NRC Safety Evaluation Reports

(NRC letters to TMI dated July 11, 1997 and April 20, 1999) on that issue. This includes the installation of new fire barrier products that replaced or upgraded Thermo Lag, a new acetylene leak detection system, sensitive incipient fire detection in several plant areas and a new water fire suppression sprinkler system in fire area FH-FZ-6. Another change that affected most pages in the report attachments was the elimination of a small area (FH-FA-7) in the 281' elevation of the Fuel Handling Building. This area contains no plant equipment and was not relied upon for post-fire safe shutdown.

The analysis was done with the assistance of a qualified fire protection engineer.

Revision 19 represents continuing changes in plant design and fire hazards analysis as of March 14, 2002. This revision includes the plant changes made to resolve the ampacity derating issue. This includes the installation of new cables for several pumps. Another change was the addition of a class A rated fire door in the Control Tower 306' elevation to the Fuel Handling Building. Also, the Control Room Habitability/Environmental envelope was improved by the addition of two double doors in the 380' elevation of the Control Tower. The Capgun Building was removed and is no longer mentioned. A change that affects most pages in Chapter 4 is the deletion of the specific types of fire extinguishers located throughout the plant.

The analysis was done with the assistance of a qualified fire protection engineer.

Revision 20 represents discrepancies, typos and errors found during the 2002 FP/FSSD Self-Assessment. These updates have no affect on the ability to achieve, maintain and monitor Fire Safe Shutdown.

The analysis was done with the assistance of a qualified fire protection engineer.

Revision 21 represents continuing changes in plant design and fire hazards analysis as of March 22, 2004. This revision updates several sections of both volumes. Most of the changes are administrative and do not impact the analysis significantly.

The analysis was done with the assistance of a qualified fire protection engineer.

Revision 22 represents discrepancies, typos and errors found during the 2003 & 2005 Focused Area Self Assessments. Inaccuracies identified during the development of the fire protection Abnormal Operating Procedures are also included in this revision. This revision updates several sections of both volumes, especially volume two attachments. Tables in several attachments had been misaligned after the deletion of a fire zone from the table; this revision corrects that misalignment. Also, this revision includes the new 1F Inverter that was installed during refueling outage 1R16.

The analysis was done with the assistance of a qualified fire protection engineer.

Revision 23 represents discrepancies, typos and errors found during the incorporation of Engineering Change Requests (ECR) posted against Revision 22 of the FHAR. Inaccuracies identified during the development of the fire protection Abnormal Operating Procedures are also included in this revision. This revision updates several sections of both volumes, especially volume two attachments. Tables in several attachments had been misaligned after the deletion of a fire zone from the table; this revision corrects that misalignment.

The analysis was done with the assistance of a qualified fire protection engineer.

Revision 24 makes several significant technical changes and significant changes in the organization and presentation of the FHAR. These changes were described and approved in 9 different ECRs.

In ECR 08-01051, the technical changes included (1) revision of the fire mitigation strategy to address the change in system response after a loss of all RCP seal cooling (described in Technical Evaluation 352410-33), (2) new analysis which establishes for the timeline for the required actions to achieve safe shutdown within 72 hours for a fire in the ESAS room and (3) changes to the scope of equipment required for fire safe shutdown. ECR 08-01051 also includes changes to Attachments 3-2, 3-3, 3-7A, 3-7B & 3-7C. The organization and presentation of Attachments 3-2 and 3-3 was revised. The tables were combined into one table which includes all active and spurious safe shutdown components, and components which involved significant discussion before being classified as not FSSD. Attachment 3-7 has also been expanded and reorganized. Attachment 3-7 is now separated into three separate attachments (3-7A, 3-7B, and 3-7C) to provide complete information on each manual action required outside the control room to achieve hot shutdown in III.G.2 fire areas (3-7A), manual actions required to achieve hot shutdown in III.G.3 fire areas (3-7B), and manual actions outside the control room and repairs required to achieve cold shutdown (3-7C). This ECR also corrected minor discrepancies, typos and errors found during the development of the Abnormal Operating Procedures or during review and approval process for the changes above.

This FHAR revision documents NRC approval for exemptions from Appendix R III.G.2 for two new manual actions (NRC letter dated March 30, 2009).

In addition the following ECRs were incorporated in revision 24:

1. ECR 08-00145, Replacement of Atmospheric Dump Valves MS-V-4A/B
2. ECR 08-00479, Update FHAR with NR-V-4A/B Manual Action & Admin Changes
3. ECR 08-00672, Update FHAR/FSAR for AOP, FASA, and NOS Identified Issues
4. ECR 08-00927, Revise FHAR Resulting from FASA and Triennial & Admin Issues
5. ECR 08-01105, “A” NDCT Demolition of Support Systems
6. ECR 09-00196, FHAR Changes from Manual Action Submittal and Other Issues
7. ECR 09-00215, Pressurizer RTD Replacement
8. ECR 09-00527, App R Control Room Evacuation Transient Analysis
9. ECR 08-01051, Revise FHAR w/CR Evacuation & Loss of Seal Cooling

Revision 25 incorporates the changes made and approved by eight ECRs. ECR 06-00687 added section 4.14 which provides analysis for the Original Steam Generator Storage Facility. This structure was constructed to house the old OTSGs which were replaced in 1R18. Likewise, ECR 08-00940 added section 4.15 to analyze the Outage Equipment Storage Building. This structure was relocated in 1R18 to the roof of the Heat Exchanger Vault to accommodate the OTSG replacement project. ECR 09-00155 revised the wording in item F.17 of section 5 to identify that the "A" NDCT no longer contains combustible material and therefore does not require a suppression system. ECRs 09-00910, 10-00100, and 10-00194 added additional Appendix R Emergency lights to the plant in order to support operator manual actions. These changes were a result of the 2011 NRC Fire Protection Triennial inspection. ECR 11-00106 revised Attachments 3-7A through 3-7C to reflect the proper lights credited with supporting the actions. In addition, Attachment 3-8 was created under this ECR to list all Appendix R emergency lights, their location in the plant, and what equipment they illuminate. Finally, IR 01167613 identified that Engineering Change Document C306691 reclassified AB-FA-2 as AB-FZ-2 but did not update the FHAR accordingly. ECR 11-00197 revised all references to AB-FA-2 as AB-FZ-2 in accordance with the changes made in C306691.

Revision 26 incorporates the changes made by and approved by eleven ECRs. Five ECRs (12-00088, 12-00571, 13-00133, 13-00177, 13-00560) updated existing discussions throughout the FHAR based on changes made during operating cycle 19. Additional changes were made by two ECRs (12-00350 and 13-00426) that incorporated enhancements and resolved issues identified in Focused Area Self Assessments, NRC Triennial Fire Protection Inspections, and Bi-Annual Nuclear Oversight Fire Protection Audits. Another significant change incorporated into this revision involves clarification of what fire zones actually require the restoration of letdown to achieve safe shutdown. This was based on updated guidance which is further described in ECR 12-00395.

Finally, three ECRs (12-00389, 12-00412, and 12-00553) incorporated changes that were identified and made as part of the Multiple Spurious Operations (MSO) Review Project. The MSO project was a voluntary initiative pursued by Exelon per the guidance provided in NRC Reg. Guide 1.189, Rev. 2 and NEI 00-01, Rev. 2. This analysis remains external to the site's licensing basis, except for unique cases where the licensing basis was impacted (such as the three ECRs described). Further discussion on this project is provided in calculation C-1101-911-E420-002.

During the T1R21 refueling outage, TMI installed new Flowserve N9000 low leakage Reactor Coolant Pump Seals, replacing the previous Westinghouse seals. The improved design characteristics associated with the new seals had a large impact on the unit's Fire Safe Shutdown strategy. During this time frame, TMI also implemented several design changes in order to comply with NRC order EA 12-049 (FLEX). In certain cases, the changes made by the FLEX initiative were able to be credited as improvements to the unit's Fire Safe Shutdown strategy. The full impact of the new Reactor Coolant Pump Seals and FLEX initiative on the Fire Safe Shutdown strategy were evaluated under ECR 14-00097. In addition to this ECR,

Revision 27 also incorporates the changes made by three additional ECRs. ECRs 14-00255 and 14-00279 document changes made to the FHAR based on fuses being added to previously un-fused DC control circuits. Finally ECR 14-00199 incorporates several changes identified during the 2013 Fire Protection Focused Area Self-Assessment and 2014 NRC Fire Protection Triennial inspection.