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April 2, 2013

UPS/Next Day Air

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U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

Docket No.: 40-3392, License No.: SUB-526

SUBJECT: HONEYWELL METROPOLIS WORKS SAFETY BASIS AND CORRECTIVE ACTION PLAN, REVISION 1

Honeywell Metropolis Works hereby submits the revised Honeywell Metropolis Works' Safety Basis and Corrective Action Plan (SB&CAP), Response to NRC Confirmatory Order EA-12-157. This document, as well as the original SB&CAP version dated November 30, 2012, provides the safety and design basis information for facility retrofits necessary to comply with the requirements described in Section IV of the Confirmatory Order issued by the NRC on October 15, 2012. The revised SB&CAP incorporates the additional information provided by Honeywell in response to the Requests for Additional Information issued on February 6 and 19, 2013.

Pursuant to the criteria set forth in NRC Regulatory Issue Summary 2005-31, the enclosed submitted herewith contains security-related sensitive information. As such, certain appropriately marked parts of this document are requested to be withheld from public disclosure under 10 CFR 2.390. In addition, we also request that all Appendices be removed entirely as also containing security-related sensitive information. To better meet NRC's expectations, Honeywell is providing the non-public and public versions of the documents.

If you have any questions, or require additional information please contact Mark Wolf, Nuclear Compliance Director, at (618) 309-5013.

Sincerely,

Mark A. Wolf for
Larry Smith

Larry A. Smith
Plant Manager

Enclosures

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PUBLIC VERSION

Honeywell International, Inc.
Metropolis Works
Docket No. 40-3392
License No. SUB-526

Safety Basis and Corrective Action Plan

Response to NRC Confirmatory Order EA-12-157

Revision 1

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I. BACKGROUND

In May 2012, NRC Staff inspectors performed a Temporary Instruction inspection (TI 2600/015) at Metropolis Works (MTW) related to NRC's "Post Fukushima" nuclear facilities assessment effort. This TI evaluated external events considered in the facility's UF6 process equipment design and licensing bases. Key findings were reported in NRC Temporary Instruction 2600-015 Inspection Report No. 40-3392/2012-006 [REF 1]:

- Inspectors noted some discrepancies between the current as-is condition of the Feeds Material Building (FMB) structure, equipment and piping versus the Integrated Safety Analysis (ISA). The various discrepancies identified were assessed significant enough to have degraded the FMB's seismic capability below that represented in MTW's licensing documents.

- It was assessed that certain tornado related accident sequences which could result in large UF6 releases were not adequately analyzed and mitigated via protective actions.

- The facility's Emergency Response Plan was assessed to be inadequate based on an apparent inability to effectively manage a larger-than-design UF6 release during certain seismic and tornado events.

During the time of the investigation, the MTW facility was shut down for annual maintenance. Following discussion with Region 2 leadership and in agreement with NRC Confirmatory Order EA-12-157 [REF 2], it was agreed the plant would not restart until plant leadership can demonstrate that the seismic and tornado design basis events result in no adverse impact to either the public or on-site workers and that the Emergency Response Plan remains adequate.

This document provides the Safety and Design Basis information for facility retrofits necessary to comply with the requirements described in Section IV of the Confirmatory Order (CO) dated October 15, 2012.

II. CONFIRMATORY ORDER RESPONSE SUMMARY

Honeywell MTW has reviewed the NRC TI inspection findings and will implement specific actions summarized below which have been determined to fully address all findings presented in NRC's TI Inspection Report No. 40-3392/2012-006 [REF 1]. Implementation of these action items is scheduled to be completed by 30 April 2013 at which time, pending final NRC approval, the facility will be returned to operating status.

A brief summary of the major improvement projects (TABLE 1) and associated Plant Features and Procedures (PFAP) (TABLE 2) being implemented in response to NRC Confirmatory Order EA-12-157 [REF 2] are provided below. These investments provide the necessary safeguards to meet risk performance requirements in accordance with Nureg 1520 for both earthquake and tornado external event hazards. Further details describing the safety design bases for these risk mitigation actions can be found in Section III - MTW SEISMIC EVENT SAFETY BASIS and Section IV – MTW WIND / TORNADO EVENT SAFETY BASIS of this document.

TABLE 1 - Summary of Major Improvement Projects

Project Elements	Description of Improvements and Retrofits
1. FMB Structure Retrofits	Retrofit structural column, brace, and connection additions or modifications in FMB structure to meet 475-yr design basis EQ.
2. FMB Equipment Restraints	Install restraints/supports for Primary Cold Traps, Distillation Vessels and Green Salt/GF2 Plant HF Vaporizers to meet 475-yr design basis EQ.
3. FMB Piping	Repair/replace/upgrade liquid UF6 Piping supports to meet 475-yr design basis EQ.
4. HF Storage Tanks	HF Storage Tanks to be decommissioned; a new HF Rail Car Direct–to-Process unloading station to be installed to meet 475-yr design basis EQ requirements.
5. NH3 Storage Tanks	Upgrade NH3 Storage Tank supports and restraints to meet 475-yr design basis EQ.
6. Main Pipe Rack	Retrofit Main Pipe Rack structure to meet 475-yr design basis EQ.
7. Seismic Safety System	Install seismically actuated shut-off valves at Primary Cold Traps, Distillation vessels, Distillation Steam Supply, HF Rail Car Unloading, NH3 Storage Tanks, GS & GF2 HF Vaporizers, Fluorination N2 Purges, GF2 Rectifiers (switches) and NG Meter Station/FMB to minimize hazardous material release quantities during a 475-yr design basis seismic or tornado event.
8. Distillation Confinement Area	Partition off the Distillation process area in FMB below the 4th floor elevation to mitigate consequences to workers and public from hazardous material releases during a 475-yr design basis EQ. Forced ventilation system for personnel comfort will discharge at 90 ft elevation.
9. Wind/Tornado Protection	Install tornado missile armor protection at NH3 Storage Tanks and in vulnerable locations on FMB exterior to meet license basis for tornado risk.

[redacted]

[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

III. MTW SEISMIC EVENT SAFETY BASIS

A. Current License Seismic Risk Assessment

1. MTW Area Seismicity

The Metropolis Works facility is located in Metropolis, Illinois, just north of the Illinois-Kentucky border. This area is directly within the area of significant influence of the New Madrid Seismic Zone (NMSZ), an area considered to feature the highest seismicity in the United States east of the Rocky Mountains. Although many smaller faults exist in Illinois, Eastern Tennessee and Southern Indiana, the NMSZ represents the controlling mechanism for maximum ground shaking intensities. The greatest earthquake hazards affecting the site are those associated with the New Madrid Seismic Zone. The NMSZ is the site of the largest historical earthquakes in the conterminous United States, the 1811-1812 series (estimated ~8 Richter magnitude event).

2. Current License Design Basis Earthquake

Recognizing the magnitude and frequency of seismic activity in the MTW region within the past 200 years, Honeywell retained Leighton & Associates [REF 3] in 1991 to analyze seismic risks and to develop conceptual seismic improvements. A 475-year return period earthquake ($2x10^{-3}$ per year frequency of occurrence) was defined as the design basis earthquake for this analysis. The mean Peak Ground Acceleration (PGA) was calculated as 0.26g. Using both the 1990 BOCA National Building Code and 1991 Uniform Building Code as guidance documents, numerous structural deficiencies were identified in the Feed Material Building (FMB) and tank farm area in addition to inadequate equipment restraints and FMB piping support systems. In 1993 EQE Engineering & Design [REF 4] developed conceptual retrofit designs for all but the piping support deficiencies. Honeywell subsequently installed the EQE recommended retrofits in 1997. No documentation exists suggesting FMB piping deficiencies were addressed at that time.

3. Current License Seismic Risk Assessment

In 2005, a seismic hazards assessment was conducted as part of an overall MTW Integrated Safety Analysis (ISA) effort requested by NRC. Based on the 475-year design basis earthquake analysis by Leighton & Associates and retrofits installed in 1997, the MTW facility was determined to present no seismic risk to the public or employees. Section 11.1 - *Seismic* of the MTW ISA Report [REF 5] states that the "*plant is designed to withstand the 475-year earthquake with no safety implications*" and thus "*there are no design basis accidents associated with seismic events*".

B. NRC TI Findings & Risk Validation

1. TI Findings

As detailed in the NRC TI inspection report dated 9 August 2012, some seismic retrofits recommended by Leighton & Associates [REF 3] were not implemented. As a result, further evaluation was required to determine whether a credible seismic event could threaten the integrity of UF6 containment as a result of piping/vessel rupture. NRC inspectors were unable to validate that Honeywell evaluated the consequences of all credible seismic events and subsequently designated Plant Features And Procedures (PFAP) and management measures necessary to minimize the risk of unacceptable consequences. In addition, the inspectors could not verify that the licensee considered all potential accident sequences as a result of credible natural phenomena events during the development of the ISA.

The TI inspection also identified concerns related to the UF6 and HF source terms used as a basis for the MTW Emergency Response Plan (ERP).

2. Existing License Source Term Definitions

a. *UF6 Source Term - FMB*

For purposes of defining the UF6 source term within the FMB during a seismic event, only "liquid" UF6 inventories significantly contribute to the hazardous consequences resulting from a UF6 spill. Solid UF6 is present only in cold traps and final product cylinders which are maintained under vacuum. Thus, air moisture infiltration into damaged cold traps or cylinders will react to form HF via hydrolysis up to the point where HF vapor generation is sufficient to equilibrate the vessel's negative pressure to atmospheric pressure. Any further HF generation occurs slowly via air moisture diffusion into the damaged vessel or cylinder. Thus, it is reasonably assumed solid UF6 inventories do not appreciably contribute to hazardous material plumes during a seismic event.

UF6 vapor density effectively minimizes the mass of UF6 present in vapor spaces of vessels and piping. Therefore, vapor UF6 is also an insignificant contributor to the overall UF6 source term.

TABLE 3 summarizes liquid UF6 mass at-risk in major FMB piping systems and vessels by floor level. Refer to REF 21 for details. [Note that administrative controls limit liquid UF6 inventory in [redacted] Assuming a worst-case UF6 release scenario whereby all liquid UF6 inventory is discharged to the environment [redacted], the estimated liquid UF6 source term is [redacted]. This scenario is assumed to be credible since the FMB structure was determined by NRC inspectors to be in non-compliance with MTW's current 475-yr EQ design basis and, therefore, at risk of significant damage from a design basis seismic event. [redacted]

[redacted]

[redacted]	[redacted]	[redacted]						[redacted]	[redacted]
		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		
[redacted]	[redacted]				[redacted]			[redacted]	
					[redacted]				
		[redacted]					[redacted]		[redacted]
		[redacted]	[redacted]						[redacted]
							[redacted]		
									[redacted]
[redacted]	[redacted]			[redacted]		[redacted]			[redacted]
[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]								[redacted]	
[redacted]	[redacted]								
	[redacted]								

Upon release of liquid UF6 to the environment, UF6 hydrolyzes in the presence of water (moisture in air) to form HF and UO2F2. NUREG/CR-6410, A-28 [REF 6] discusses the release of liquid UF6 and the subsequent formation of a solid UO2F2 crust on top of the liquid pool. This precipitated coating, combined with liquid UF6 solidification due to evaporative cooling from HF vapor evolution, prevents further reaction of liquid UF6 with air moisture. Thus, only a fraction of the liquid UF6 spill results in the formation of HF; this fraction is referred to as the "Release Fraction" (RF). Based on process temperature and pressure at the point of release, RFs typically range between [redacted] for MTW processes of interest. Unless otherwise specifically stated, sufficient air moisture is assumed available to allow 100% hydrolysis of available UF6 for all MTW release calculations.

[redacted]

b. *HF Source Term – Tank Farm*

MTW is licensed to maintain [redacted] of anhydrous HF on-site in a combination of [redacted] storage tanks and rail cars. Maximum Tank Farm inventory is [redacted]; the balance of inventory is maintained in DOT 112S500W class rail cars which meet DOT regulation DOT-SP 11759. These HF rail cars are specifically designed to DOT code specifications to prevent releases upon roll-over and have sufficient shell wall thickness [redacted] to prevent penetration from a design basis tornado [redacted] [REF 20]. Therefore, the worst case Tank Farm HF source term is assumed to be release of [redacted] of anhydrous HF due to rupture of [redacted] on-site HF storage tanks [redacted] during a design basis earthquake or tornado event.

c. NH3 Source Term – Tank Farm

Anhydrous NH3 is stored on-site in [redacted] storage tanks with a combined inventory of [redacted]. Although anhydrous ammonia is not a licensed material, release of large quantities may impact safe operation [redacted]. The worst case Tank Farm NH3 source term is assumed to be release of [redacted] of anhydrous HF due to rupture of [redacted] storage tanks or [redacted] during a design basis earthquake or tornado event.

3. Worst Case Risk Determinations

a. UF6 Release - FMB

Dispersion modeling of a [redacted] liquid UF6 release was developed using RASCAL v4.1 software to validate level of risk imposed by the current seismic-related structural deficiencies identified in the FMB and tank farm. The HF plume concentration profile shown in FIGURE 1 indicates average [redacted] concentrations [redacted] The nearest residence receptor is at [redacted] of the facility. [redacted] Deposition of [redacted] during the event also results in an off-site uranium toxicity concern. [redacted] Detailed RASCAL output data are provided in [REF 8].

[redacted]

Modeling input assumptions are listed below:

- Initiating event frequency: 475-yr EQ ($2x10^{-3}$ per yr)
- Source terms: [redacted]
- [redacted]
- AEGL (60 min) values: Refer to current MTW ISA Consequence Table (Table - 3 below
- Meteorological conditions: wind @ 4 mph from 270°, Stability Class D, no precipitation

Risk Assessment: [redacted] (based on Likelihood & Consequence definitions per current MTW ISA Report [REF 5])

Likelihood: Not Unlikely (EQ frequency [redacted]

Consequence Severity: Public - [redacted]

Worker - [redacted]

[redacted]

[redacted]

b. HF Release – Tank Farm

Release of anhydrous HF from the Tank Farm was modeled using SAFER TRACE dispersion modeling software in accordance with EPA Risk Management Plan requirements (40 CFR 68, Subpart B Hazard Assessment). Methodology and modeling results are documented in MTW-ADM-RMP-0003 r0 Risk Management Plan Hazard Assessment [REF 23] and briefly summarized below:

- Worst-case scenario: release of [redacted] anhydrous HF [redacted]
- Release rate: [redacted]
- [redacted]
- Distance to End-Point: [redacted]

Risk Assessment: [redacted] (based on Likelihood & Consequence definitions per current MTW ISA Report [REF 5])

Likelihood: Not Unlikely (EQ frequency [redacted])

Consequence Severity: Public - [redacted]

Worker - [redacted]

c. *NH3 Release – Tank Farm*

Release of anhydrous NH3 from the Tank Farm was modeled using SAFER TRACE dispersion modeling software in accordance with EPA Risk Management Plan requirements (40 CFR 68, Subpart B Hazard Assessment). Methodology and modeling results are documented in MTW-ADM-RMP-0003 r0 Risk Management Plan Hazard Assessment [REF 23] and briefly summarized below:

- Worst-case scenario: release of [redacted] anhydrous NH3 [redacted]
- Release rate: [redacted]
- [redacted]
- Distance to End-Point: [redacted]

Risk Assessment: [redacted] (based on Likelihood & Consequence definitions per current MTW ISA Report [REF 5])

Likelihood:	Not Unlikely (EQ frequency [redacted])
Consequence Severity:	Public - [redacted]
	Worker - [redacted]

C. Seismic Risk Mitigation

1. Revised Definition of Risk Terms

a. *Likelihood Risk Performance Definition*

Per guidance in Nureg 1520, Appendix D, Natural Phenomena Hazards, and as directed by Confirmatory Order EA-12-157 [REF 2], the Likelihood Risk Terms for rare seismic external event risk analysis at MTW are defined as shown in TABLE 4. These definitions apply only to seismic events and are not applicable to the Tornado risk analysis discussed in Section IV – MTW Wind/Tornado Event Safety Basis. Note that these parameters differ from Nureg 1520 Appendix A, Table A-6 guidance but are consistent with Likelihood definitions utilized by other existing nuclear fuel cycle facilities for seismic risk analyses.

TABLE 4 – Seismic Total Risk Likelihood Categories

	Likelihood Category	Probability of Occurrence
Not Unlikely	3	More than 10^{-3} per event, per year
Unlikely	2	Between 10^{-3} and 10^{-4} per event, per year
Highly Unlikely	1	Less than 10^{-4} per event, per year

b. *Consequence Risk Performance Definition*

Consequence Severity categories are defined based on MTW ISA Report, Section 4.3.1-Defining Consequence Severity Categories and Section 4.3.2-Worker Exposure Assumptions [REF 5]. TABLE 5 provides enhanced values for normalizing chemical exposure to values appropriate for the time intervals under consideration. The rationale associated with exposure times are defined in MTW ISA Report, Section 4.3.2 [REF 5].

TABLE 5 – Enhanced Definition of Consequence Severity Categories

		High Consequence (Category 3)	Intermediate Consequence (Category 2)
Acute Radiological Dose	Worker	>100 rem TEDE	>25 rem TEDE
	Outside Controlled Area	>25 rem TEDE	>5 rem TEDE
Acute Radiological Exposure	Worker	Not applicable	Not applicable
	Outside Controlled Area	>30 mg U intake	>5.4 mg U/m3 (24-hr average)
Acute Chemical Exposure	Worker (local) (1-min exposure)	>40 mg U intake >1,300 mg HF/m3	>10 mg U intake >137 mg HF/m3
	Worker (elsewhere in room) (2.5-min exposure)	Note 1, Note 2	>30 mg U/m3 Note 2
	Worker (elsewhere in room) (5-min exposure)	>298 mg U/m3 >175 mg HF/m3	>24 mg U/m3 >98 mg HF/m3
	Outside Controlled Area (30-min exposure)	>13 mg U/m3 >28 mg HF/m3	>2.4 mg U/m3 >0.8 mg HF/m3

Notes: 1. Use the conservative 5-minute exposure value for uranium.
2. Use the conservative 5-minute exposure value for hydrogen fluoride.

c. *Acceptance Criteria for Seismic Risk*

Based on the likelihood definitions for seismic events described in Section III.C.1.a and the enhanced definitions of severity categories defined in Section III.C.1.b, seismic risk acceptance criteria are summarized in TABLE 6.

TABLE 6 – Seismic Risk Matrix

	Likelihood for Seismic Events (per event, per year)		
	Highly Unlikely ($<10^{-4}$)	**Unlikely (between 10^{-3} & 10^{-4})**	**Not Unlikely (>10-3)**
High Consequence	Acceptable Risk	**Unacceptable Risk**	**Unacceptable Risk**
Intermediate Consequence	Acceptable Risk	Acceptable Risk	**Unacceptable Risk**
Low Consequence	Acceptable Risk	Acceptable Risk	Acceptable Risk

2. MTW Seismic Upgrades Development

a. *Seismic Design Basis for TI Compliance Scope Items*

As described in Section III.A.2 and further cited in MTW ISA Report, Section 11.1 Seismic [REF 5], Confirmatory Order EA-12-157 pg 3 and EA-12-157 Enclosure pg 1-2 [REF 2], the current MTW NRC license design basis EQ is a 475-year return period seismic event with seismic ground motion parameters as defined by the 1991 Leighton & Associates study [REF 3]. More recently, MTW structures were analyzed using 2002 USGS mapping values ([redacted], FMB Structural Seismic Evaluation Report, 17 June 2011) [REF 10] in anticipation of a revised Part 40 Rule. The current 475-yr design basis EQ was retained and the more current and conservative 2002 USGS mapping ground force parameters were adopted to build additional robustness and design safety margin into the TI Compliance seismic retrofits.

Design bases for all NRC TI compliance scope items are described below:

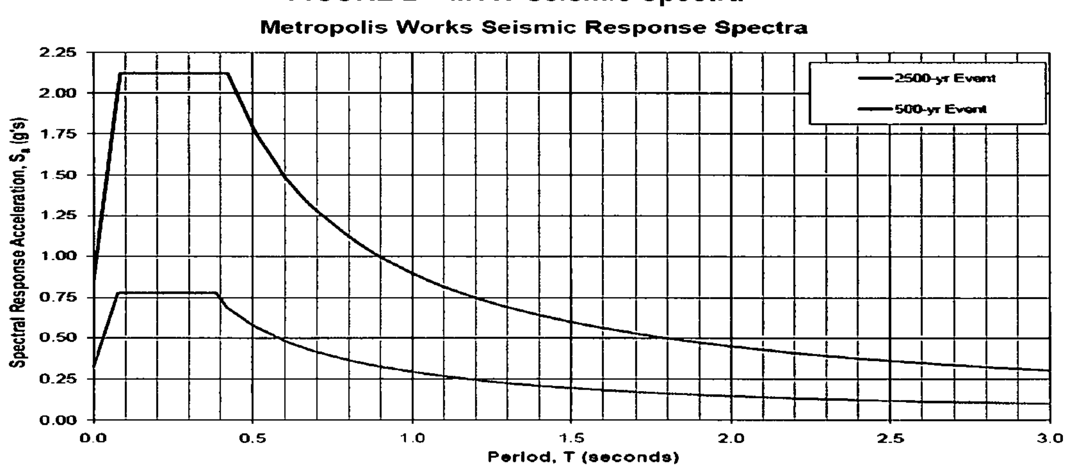
- Design Basis Earthquake - 475-yr return period
- Seismic ground force parameters - 2002 USGS Mapping; PGA = 0.31g
- Spectral Acceleration data – refer to TABLE 7 & FIGURE 2 (Source: [redacted], FMB Structural Seismic Evaluation Report, Section 5.5, 17 Jun 2012) [REF 10]
- ASCE 41 Design Criteria – "Immediate Occupancy", Importance Factor =1.5

TABLE 7 - ASCE 31 Region of Seismicity Classification 475-Year Ground Motion – Metropolis, Illinois

Mapped Spectral Accelerations	ASCE 31 Region of Seismicity *					
0.2 Sec. (S_S): 0.585g						
1 Sec. (S_1): 0.126g						
	Low		Moderate		High	
	S_{DS} $<0.167g$	S_{D1} $<0.067g$	$0.167<S_{DS}$ $<0.50g$	$0.067<S_{D1}$ $<0.20g$	S_{DS} $>0.50g$	S_{D1} $>0.20g$
Short Period Spectral Response Acceleration (S_{DS})					**0.779g**	
One Second Spectral Response Acceleration (S_{D1})						**0.289g**

* Highest classification governs between the short period and one second spectral response

FIGURE 2 – MTW Seismic Spectra



b. *Seismic Event Accident Sequences*

Based on the "not unlikely" likelihood of a 475-yr design EQ ($2x10^{-3}$ per yr) and "[redacted] consequence severity resulting from release of hazardous materials [redacted] during an event, TABLE 8 summarizes the credible Seismic Accident Scenarios and likely component failure modes leading to potential hazardous material releases capable of impacting safe operation of the liquid UF6 processes in the FMB.

TABLE 8 – Seismic Accident Scenarios

Seismic Accident Sequences	Component Failure Modes
Release of UF6 ([redacted] in FMB	[redacted]
NH3 Release in Tank Farm	[redacted]
HF Release at HF Vaporizers (Green Salt & GF2 Plant)	[redacted]
HF/NH3 Release on Main Pipe Rack	[redacted]
HF Release at HF Rail Car Unloading Station	[redacted]

c. *Seismic Safe-Guards Identification and Scope Description*

In 2010, MTW initiated a site-wide seismic assessment study in advance of the anticipated requirements of a revised Part 40 Rule. This study formed the basis for determining the seismic safe-guards necessary to meet the requirements of the NRC TI Confirmatory Order. Two distinct approaches were employed to evaluate a) seismic adequacy of existing structures, systems and components (SSC) and b) conceptual modifications necessary to enhance seismic ruggedness:

- Approach 1 involved detailed engineering analysis of SSC where sufficient definitive design and construction documentation existed to support quantitative analytical and design techniques.

- Approach 2 was based on a detailed walk-down/observation of the facility by a team consisting of a seismic capability engineer, structural/piping engineers and knowledgeable plant staff to provide sufficient information to determine qualitatively apparent and/or suspected vulnerabilities and possible solutions.

The assessment approach employed by SSC type to be analyzed is shown in TABLE 9 below:

TABLE 9 – Seismic Reassessment Methodologies

SSC type	Assessment Methodology	Assessor(s)	Study Results / References
Large structures & buildings	Approach 1: Finite Element Analysis (FEA), linear dynamic seismic modeling, detailed stress calculations	[redacted]	[redacted]
Major process equipment	Approach 1: Detailed stress analyses as required	[redacted]	[redacted]
Other process equipment & components	Approach 2: Expert walk-down, qualitative assessments, simplified and/or detailed stress analyses	[redacted]	[redacted]
Piping systems	Approach 2: Expert walk-down, limited pipe stress analyses as needed	[redacted]	[redacted]

Seismic and civil/structural experts from [redacted] led all activities during the assessment study and provided required engineering services for development of seismic upgrade options. A detailed description of the expert walk-down approach, methodology followed and recommendations is provided in MTW-RPT-GEN-0008 [redacted] Project Report, MTW Seismic Reassessment and Upgrade, 22 Jun 2012 [REF 9]. Note that recommendations in this report reflect a comprehensive review of the entire MTW facility. SSC recommendations pertaining specifically to the NRC TI findings report represent a subset of this larger body of work.

To expedite correction of deficiencies as defined in the NRC TI findings report, as well as to maintain consistency with MTW's on-going ISA effort to satisfy the anticipated revised Part 40 Rule, the following specific recommendations from the seismic walk-down report were selected for implementation to comply with the NRC TI Confirmatory Order. In all cases the selected improvement projects meet or exceed the current license design basis requirements such that the plant is designed to withstand the 475-year earthquake with no safety implications.

Additional details for each scope item are included in the Design Basis Documents in Appendix A.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted] during the same [redacted]

[redacted]

[redacted] [redacted]

[redacted]

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- [redacted]
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[redacted]

In addition to the aforementioned passive and active engineered controls, specific Management Measures (Configuration Management, Management of Change, Mechanical Integrity, Operations Surveillance, etc) will be defined to ensure the availability and reliability of each safe-guard.

3. Modified Seismic Design Risk Assessment

a. *Likelihood Determination*

To meet risk performance requirements described in Section III.C.1 for each seismic accident scenario described in TABLE 8, specific Plant Features And Procedures (PFAPs) are assigned to reduce the likelihood of each accident scenario and/or eliminate or mitigate hazardous material release consequences. PFAPs itemized in TABLE 10 consist of the various retrofit project scopes described in Section III.C.2.c.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

FMB Event Tree Risk Analysis – an Alternative Perspective

To achieve risk performance requirements established by Nureg 1520, multiple layers of protection (i.e., defense in depth) are employed [redacted] to reduce the likelihood and/or consequence severity resulting from a hazardous material release ([redacted]) due to a 475-yr design EQ. The Event Tree shown in FIGURE 3 depicts the various protection layers to be implemented in response to the TI findings.

Note that this Event Tree analysis is intended to highlight the relative contribution of each successive protection layer to the overall likelihood for each accident event scenarios shown. Likewise, it <u>qualitatively</u> demonstrates risk sensitivities at several seismic damage conditions. It is <u>not intended</u> to provide defensible quantification of [redacted] overall hazardous material release frequencies post-retrofits since the fragility values described in TABLE 11 are "best estimates" based on expert input and have not been determined from actual quantitative engineering data.

- [redacted]
- [redacted]

[redacted]

- [redacted]
- [redacted]

[redacted].

[redacted]

[redacted]

[redacted]

[redacted]

b. *Consequence Determination – 475-yr Design*

At the 475-yr design basis EQ, there are no "Unlikely" or "Not Unlikely" accident scenarios resulting in Intermediate or High Consequences to the public or worker. The robust seismic retrofits as described in Section III.C.2.c and TABLE 10 preclude equipment or piping damage sufficient to release hazardous materials.

c. *Other Seismic Safe-Guards – Seismic Safety System*

Not shown on FIGURE 3 - Event Tree but described in Section III.C.2.c, the Seismic Safety System contributes significantly to overall seismic safety of the site. This system consists of seismically activated shut-off valves [redacted]

Purpose and function of these valves are to "lock in" UF6 inventory during a seismic event to prevent loss of hazardous materials to the environment. Valves installed specifically for seismic or tornado risk management purposes are classified as PFAPs and will be managed according to Nureg 1520 requirements (Mechanical Integrity, Configuration Management, Reporting, etc). Other select valves are being installed for *asset protection* purposes. Although these valves are not classified as PFAPs as they are not required to meet risk performance requirements, they will be managed comparably to Nureg 1520 requirements. All Seismic Safety System valves will be actuated via the Seismic Safety System PFAP trip system. Actuation of non-PFAP valves will neither interfere with nor impede proper functioning of PFAP seismic safety valves.

d. *NH3 Storage Tanks, Main Pipe Rack and HF Rail Car Unloading Facility - Risk Analyses*

NH3 Storage Tanks

As described in Section III.B.3.c, unmitigated consequences were conservatively analyzed for the worst case release defined as the total contents of the largest NH3 vessel ([redacted] per MTW's EPA Risk Management Plan (40 Code of Federal Regulations (CFR) 68, – "Chemical Accident Prevention Provisions," Subpart B – Hazard Assessment). SAFER TRACE modeling results show the NH3 [redacted] toxic end point extends [redacted] at a release rate of [redacted]. Since the existing tank structures pre-retrofit are insufficient to prevent displacement of these vessels during a design basis EQ event, the likelihood of release is equivalent to the initiating event frequency ([redacted]

Following retrofit [redacted] the NH3 tanks will be capable of withstanding ground motion forces from a design basis 475-yr EQ. These retrofits have been assessed by a seismic capability engineer and structural/piping experts to have sufficient seismic safety margin to protect against NH3 releases from beyond design basis EQ ground motions up to the design safety margin limit [redacted]. Therefore a release from the NH3 storage tanks is "Highly Unlikely". A [redacted] Administrative Control provides additional protection for workers for beyond design basis events.

Main Pipe Rack

Unmitigated release modeling for the pipe rack was not developed. The pipe rack is being designed to withstand a 475-yr design basis EQ with an Importance Factor = 1.5 per ASCE 41 code. Thus, a release from a design basis EQ event up to the design safety margin limit [redacted] is "Highly Unlikely". The design also assumes an Importance Factor = 1.5 for structural design. A [redacted] Administrative Control provides additional protection for beyond design basis events.

HF Rail Car Unloading Area

The new HF rail car unloading project is being designed to withstand a 475-yr design basis EQ. The design also incorporates an Importance Factor = 1.5 for structural robustness per ASCE 41 code. Following retrofits and based on expert walk-down feedback, this structure is expected to far exceed the capability needed to survive a design basis seismic event. Therefore, it is reasonably estimated the structure's design safety margin is sufficient to protect against HF releases from beyond design basis EQ ground motions up to the design safety margin limit [redacted]. A [redacted] Administrative Control provides additional protection for workers for beyond design basis events.

Risk Conclusion:

Following seismic retrofits as described herein and based on expert walk-down feedback, these structures by design are expected to demonstrate the capability to survive a design basis seismic event up to the design safety margin limit [redacted]. Thus, there are no seismic design basis accidents associated with the NH3 Storage Tanks, Main Pipe Rack and HF Rail Car Unloading Area facilities.

e. *Beyond Design Basis Earthquakes*

Post-installation of PFAPs described in Section III.C.2.c, release of UF6 due to damage from a 475-yr design basis EQ is highly unlikely. [redacted] However, for beyond design basis earthquakes (>475-yr EQ events), some damage [redacted] may occur due [redacted] as the magnitude of the event approaches the [redacted] seismic safety margin limit. The limit of the [redacted] safety margin (SM) is currently under investigation using a rigorous non-linear static push-over analysis technique. The outcome of this work will be reported to NRC when completed (target completion – [redacted]).

Piping Damage

For beyond design basis seismic events up to the [redacted] SM limit, the most credible worst case scenario is defined as [redacted] mechanisms resulting from beyond design basis EQ events [redacted] Based on expert walk-down assessments, [redacted] post-retrofit is robust and anticipated to be capable of withstanding EQ forces up to the [redacted] design safety limit. This performance is attributable [redacted]

Vessel Damage

Beyond design basis EQ events may also result in material releases from vessels via 3 mechanisms:

[redacted]

As ground motion increases beyond design basis up to [redacted] SM limit [redacted]), no loss [redacted] due to vessel dislodgement is expected since all vessels and restraints were assessed by a seismic capability engineer to be adequate up to the [redacted] safety margin limit. Some loss may occur [redacted]; however, these material losses are mitigated via closure of seismically activated isolation valves [redacted] Loss of containment from [redacted] is highly unlikely since [redacted] are designed to withstand ground motions up to the design SM limit.

Consequence - Dispersion Modeling

For beyond design basis seismic events up to the [redacted] SM limit, the following worst case credible [redacted] release scenarios were defined as bounding cases. Details pertaining to these [redacted] dispersion analyses are fully described in [redacted], MTW Dispersion Modeling Results, Feb 2013 [REF18] and RASCAL modeling results in Section III.B.3 [REF 8].

[redacted]

[redacted]

[redacted]

A brief summary of modeling results is provided in TABLE 12 below with key conclusions following:

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

- [redacted]
- [redacted]
- [redacted]

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f. *Other Considered Seismic-Related Risk Analyses*

Loss of Power

A Loss of Power Hazards Assessment [REF 28] confirms that MTW process facilities [redacted], as currently configured and/or as configured following completion of the SBCAP retrofits, will shut-down in a safe manner upon loss of power. All safety-related process control valves are designed to fail-safe ([redacted]) to achieve this safe state. Details pertaining to specific process safety system designs are described in individual process area hazard reviews [redacted] Therefore, there are no credible accident scenarios associated with Loss of Power.

Natural Gas Fire and Explosion

The Natural Gas (NG) supply to the MTW plant-site is automatically shut-off at the incoming plant metering station via a seismically actuated shut-off valve triggered by the Seismic Safety System. Consequently, the volume of NG available to be released during a design basis or beyond design basis EQ is limited to the total volume of the NG piping system within the MTW site at an incoming line supply pressure [redacted]. Based on MTW-CALC-GEN-0014 Natural Gas Pipe Volume/Flammability [REF 27], the total NG volume in the plant-wide supply header system operating at [redacted]. At atmospheric pressure, a maximum [redacted] could be discharged [redacted] if the entire supply header emptied [redacted]. Applying the Baker-Strehlow [REF 27] approach for modeling vapor cloud explosions, near-field overpressures [redacted] are predicted. [redacted]

To protect against discharge [redacted], a seismically actuated NG shut-off valve is installed in the NG supply header [redacted] This valve automatically shuts-off NG supply upon detection of ground motion above threshold limits and vents [redacted] to a safe location [redacted]. By so doing, the maximum quantity of NG at risk of being discharged [redacted] is limited [redacted]

[redacted]

For seismic events beyond the 475-yr design basis EQ up to the [redacted] safety margin limit, the potential exists for "jet" fire hazards to occur due to small NG line breaks. However, venting [redacted] to a safe location upon detection of a seismic event greatly reduces the likelihood of a jet fire continuing unabated for any appreciable duration. [redacted] Since the plant is designed to fail-safe [redacted] as described in the MTW Loss of Power Process Hazards Assessment [REF 28], damage [redacted] will not cause a material release hazard. Transient flammables are controlled via a site-wide fire protection procedure MTW-ADM-FPP-0001 Control of Transient Combustibles and Ignition Sources [REF 29]. Therefore, there are no credible high or intermediate level consequences from a short-duration NG jet fire.

Loss of Instrument Air or Nitrogen

Release of instrument air and/or nitrogen due to a seismic event was considered; however, there are no credible toxicity consequences. Loss of availability of these utility services was considered; however, appropriate safeguards are in-place as needed to ensure no process safety impacts [redacted]

g. *Design Safety Margin - Beyond Design Basis Events*

The seismic ruggedness provided by [redacted] upgrades described in Section III.C.2.c yields safety margin above the current MTW license 475-yr seismic design basis. A major contributing factor is utilization of the "Immediate Occupancy" Importance Factor ($I_f = 1.5$) per ASCE 41 *Seismic Evaluation & Design Criteria* guidance for buildings and structures where hazardous materials are present. This conservative design approach provides additional margin above typical "Life Safety" design criteria and enhances surety that no hazardous material releases will occur [redacted] during a design basis EQ event.

Also providing conservatism above current design basis is utilization of 2002 USGS seismic mapping values. The current design basis developed in 1991 by Leighton & Associates [REF 3] applied a lower PGA = 0.26g compared to the updated 2002 USGS seismic mapping value of 0.31g.

To quantitatively define [redacted] design safety margin limit following seismic retrofits, a rigorous [redacted] analysis will be performed [redacted] These capacities will be used with generic structural information to develop a fragility curve [redacted]. The fragility curve will be combined with the 2008 USGS seismic hazard curve to develop an equivalent Peak Ground Acceleration (PGA) and EQ return period. (Note: 2008 USGS map values will be used for this safety margin analysis to account for additional margin built into retrofit designs developed using ASCE 41 code and the more conservative 2002 USGS map values.) The results from the [redacted] analysis will be reported to NRC when completed (target completion – [redacted]).

Also contributing to beyond design basis EQ safety margin are the following non-PFAP actions voluntarily adopted by Honeywell to further protect both workers and physical assets:

1. Seismically activated shut-off valves [redacted]
2. [redacted]
3. Administrative controls [redacted]

h. Overall Seismic Risk Summary – Post-Retrofits

Following implementation of the NRC TI Confirmatory Order actions discussed above, the following seismic risk conclusion is made:

Initiating Event:
$2x10^{-3}$ per year (475-yr return design basis earthquake at 0.31g PGA).

Accident Scenarios:
No "Unlikely" or "Not Unlikely" accident scenarios at 475-yr seismic design basis event up to design safety margin limit [redacted] (limit to be determined by quantitative [redacted] analysis).

Consequences:
Following full implementation of scope upgrades (PFAPs), discussed in Section III.C.2.b, the [redacted] are judged to be fully capable of withstanding design basis EQ ground forces without material releases. Therefore, the following conclusions can be made:

1. **No design basis accidents affect public.**
2. **"Highly Unlikely" single accident scenario** [redacted]

Risk Conclusion: **MTW UF6 process presents an acceptable level of risk to the public and workers resulting from design basis seismic events.**

IV. MTW WIND / TORNADO EVENT SAFETY BASIS

A. Existing License Tornado Design Basis

The existing MTW ISA analysis of tornado vulnerability (refer to MTW ISA Report, Tornado, Tornado Missile and High Wind, Section 11.2 [REF 5]) concluded that the frequency of a direct tornado strike at MTW is < 10^{-6}/yr, thus not a credible event. However, likelihood of a tornado missile hitting the FMB or tank farm was determined to be 1×10^{-6}/yr, a borderline design basis event. Review of vessel wall thicknesses found that all tanks in the tank farm had wall thicknesses > 0.38", the critical wall thickness to prevent penetration from a design missile strike. Therefore, the conclusion drawn from the above analyses was that there is "no design basis accident associated with tornados that require a PFAP".

B. TI Findings

As detailed in the NRC TI inspection report dated 9 August 2012 [Ref 1], inspections during the TI identified vulnerabilities to HF piping in the tank farm as well as liquid UF6 equipment and piping in the FMB. Additionally, the method used to evaluate tornados did not follow guidance provided in Nureg/CR-4461.

C. Tornado Risk Mitigation

1. Definition of Risk Terms

a. *Likelihood*

Per TABLE 13, MTW's tornado risk analysis utilizes Nureg 1520 Appendix A Table A-6 definitions for Likelihood which is consistent with Likelihood definitions referenced in the existing MTW ISA Report [REF 5].

TABLE 13 – Tornado Total Risk Likelihood Categories

	Likelihood Category	Probability of Occurrence
Not Unlikely	3	More than 10^{-4} per event, per year
Unlikely	2	Between 10^{-4} and 10^{-5} per event, per year
Highly Unlikely	1	Less than 10^{-5} per event, per year

b. *Consequence*

For purposes of determining consequence severity from tornado missile strikes, it is assumed the resulting consequence from any tornado event results in a "High Consequence" severity event. This is a conservative position and applies in all cases involving tornado hazards.

c. *Acceptance Criteria for Tornado Risk*

Based on the MTW ISA Report [REF 5], the likelihood definitions for tornado events (Section IV.C.1.a), and the definition of severity categories (Section IV.C.1.b), TABLE 14 summarizes the acceptance criteria for tornado events.

TABLE 14 – Tornado Risk Matrix

	Likelihood for Tornado Events (per event, per year)		
	Highly Unlikely ($<10^{-5}$)	Unlikely (between 10^{-4} & 10^{-5})	Not Unlikely ($>10^{-4}$)
High Consequence	Acceptable Risk	Unacceptable Risk	Unacceptable Risk
Intermediate Consequence	Acceptable Risk	Acceptable Risk	Unacceptable Risk
Low Consequence	Acceptable Risk	Acceptable Risk	Acceptable Risk

2. Modified Tornado Risk Analysis

MTW-CALC-GEN-005 Tornado Strike Likelihood [REF 19] calculations were prepared in accordance with Nureg/CR-4461 by Enercon in preparation for meeting requirements of the anticipated new Part 40 rule ISA. Per that calculation, the frequency of tornado interactions with the MTW site was determined to be 4.4×10^{-4}/yr. Since this frequency exceeds the non-credible events threshold (1×10^{-6}/yr) in the MW ISA, tornados must be considered a credible event.

Maximum wind speed for an "Unlikely" (1×10^{-5}/yr frequency) tornado at MTW is calculated to be 152 mph. Missile types to be considered are metal pipe and automobile per 10 C.F.R. § 70.61(b)(4) guidance.

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- [redacted]
- [redacted]
- [redacted]

5. TI Compliance Tornado Scope Items

To expedite protection of vulnerable equipment identified in Section IV.C.4.b., the tornado protection projects identified as part of the anticipated new Part 40 rule ISA effort will be fully implemented. In all cases these improvement projects meet or exceed the current license design basis requirements such that "there are no "Intermediate" or "High" consequences due to credible missile strikes.

Additional details for each scope item are included in the Design Basis Documents in Appendix B.

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[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

7. Overall Risk Assessment with TI Compliance Upgrades

[redacted] it is assumed a tornado affecting the site could lead to a high consequence event. Calculation MTW-CALC-GEN-005 [REF 19] shows that the likelihood of a tornado striking the facility is [redacted] [redacted]. By implementing the controls discussed in Section IV.C.5, compliance with the risk performance requirements is demonstrated.

V. EMERGENCY RESPONSE PLAN (ERP)

VI. EMERGENCY RESPONSE PLAN (ERP)

A. Introduction

The Emergency Response Plan in its entirety, which includes supporting procedures, has been developed to address industrial incidents and natural disasters. The Plan's intent is to minimize hazards to the public, employees and the environment. Through the Emergency Response Plan the site can facilitate the orderly assembly of plant personnel and activate the Emergency Response Organization to recognize, respond to and mitigate emergency conditions at the site. Whether the incident is initiated by a process upset or natural disaster the plan can adapt to the situation.

Honeywell has responded to natural disasters by improving the process building structural supports, equipment and piping restraints, reducing significant chemical source terms, installing seismic recognition instrumentation, engineering confinement, and protecting critical assets from severe wind and tornado debris.

Improvements to [redacted] structure are engineered to withstand a 475-year return period earthquake. Honeywell is adding engineering improvements to the structure commensurate with Immediate Occupancy criteria to provide an additional margin of safety. The amount of margin is still being analyzed, however, it's expected to provide a significant improvement over the original 475-year goal. Process vessels and process piping are being strengthened using earthquake engineering recommendations. [redacted] These engineered restraints reduce the likelihood of mechanical damage to the vessels thereby greatly improving survivability during a seismic event. Continuing with improved safety to process integrity, Honeywell reviewed piping and made improvements inside and outside the FMB.

Honeywell discontinued the production of IF5, SbF5 and SF6 at the Metropolis site which eliminated the need to store approximately [redacted] on-site. The plant now only produces gaseous fluorine which is immediately consumed in the fluorination step of UF6 production. [redacted] The fluorine gas is only produced when the consumer fluorination reactor is in operation.

Analysis of the liquid anhydrous hydrogen fluoride (AHF) storage tanks revealed a weakness in the structures which could cause a release during a seismic event. Following this discovery Honeywell removed the AHF tanks from service completely. [redacted] To replace the AHF storage tanks, Honeywell engineered a system to allow the plant to operate directly from rail cars. AHF rail cars meet DOT-SP-11759 requirements which are designed to prevent releases in the event of a roll-over during transportation. An equivalent analysis of anhydrous ammonia (ANH3) storage tanks was also performed. [redacted]

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