



Metropolis Works Upgrades

Honeywell

Metropolis Works Facility

Plant Background

- Metropolis Works (MTW) is a chemical plant that produces uranium hexafluoride (UF_6), the first step in making nuclear reactor fuel
- Only U.S. producer of UF_6
- Operates under a license from the U.S. Nuclear Regulatory Commission (NRC)

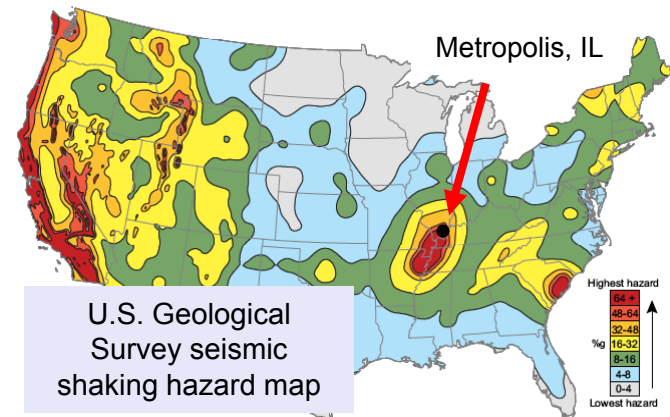
Location

- Located in southern Illinois just across the river from Paducah, Kentucky
- Largest employer in Metropolis after local casino
- Historical nuclear materials area with USEC enrichment nearby

NRC Inspection

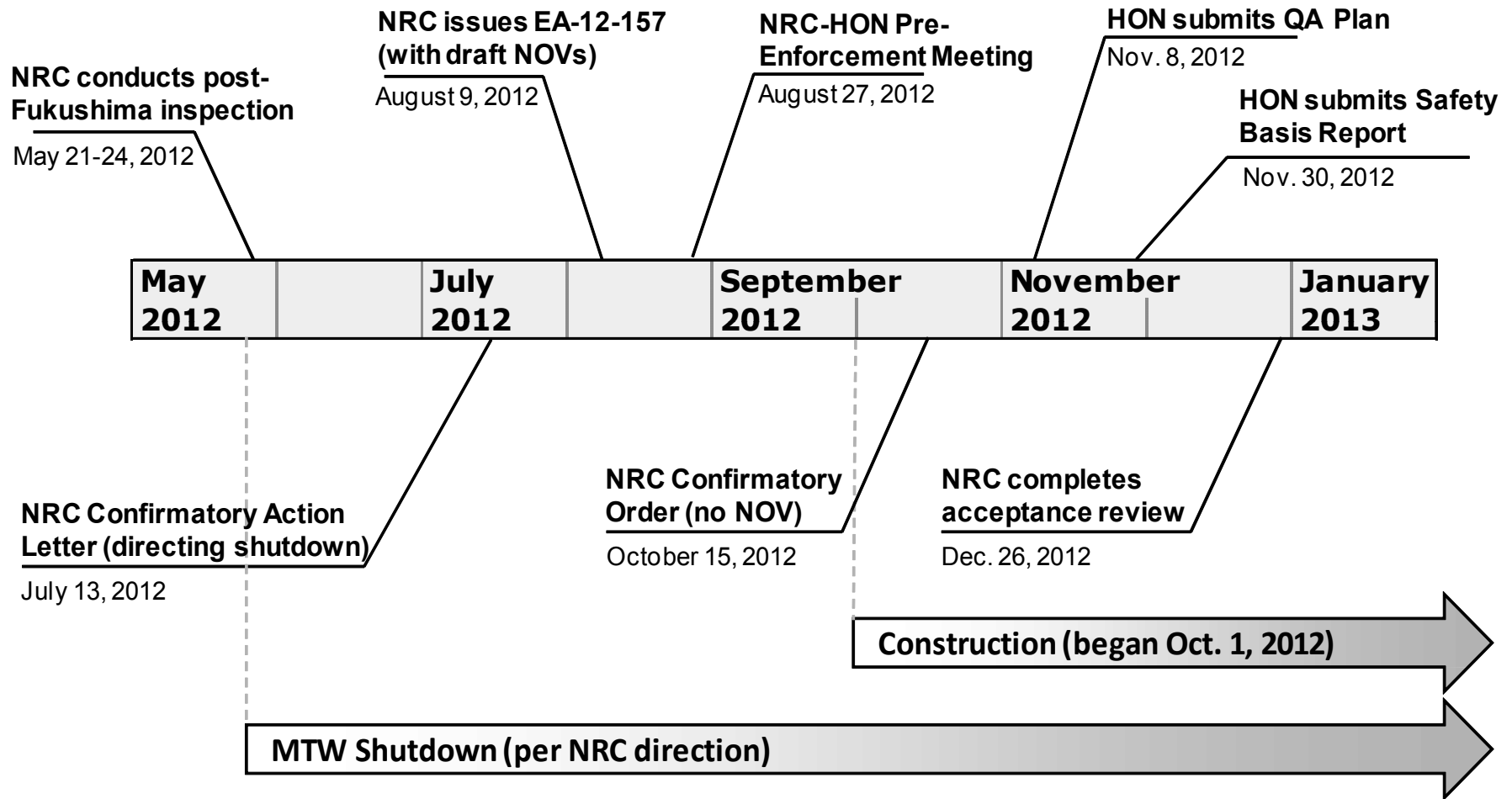
- Following Fukushima event, NRC conducted a Temporary Instruction inspection in early 2012
- NRC determined the site needed upgrades to withstand severe natural disasters (earthquakes and tornados)
- NRC/company agreed in Oct. 2012 on scope of work to at least meet “475-year” seismic event required by NRC license

- Metropolis Works is located near the New Madrid fault
- Last significant earthquakes in 1811-12
- Plant also in area of high tornado activity



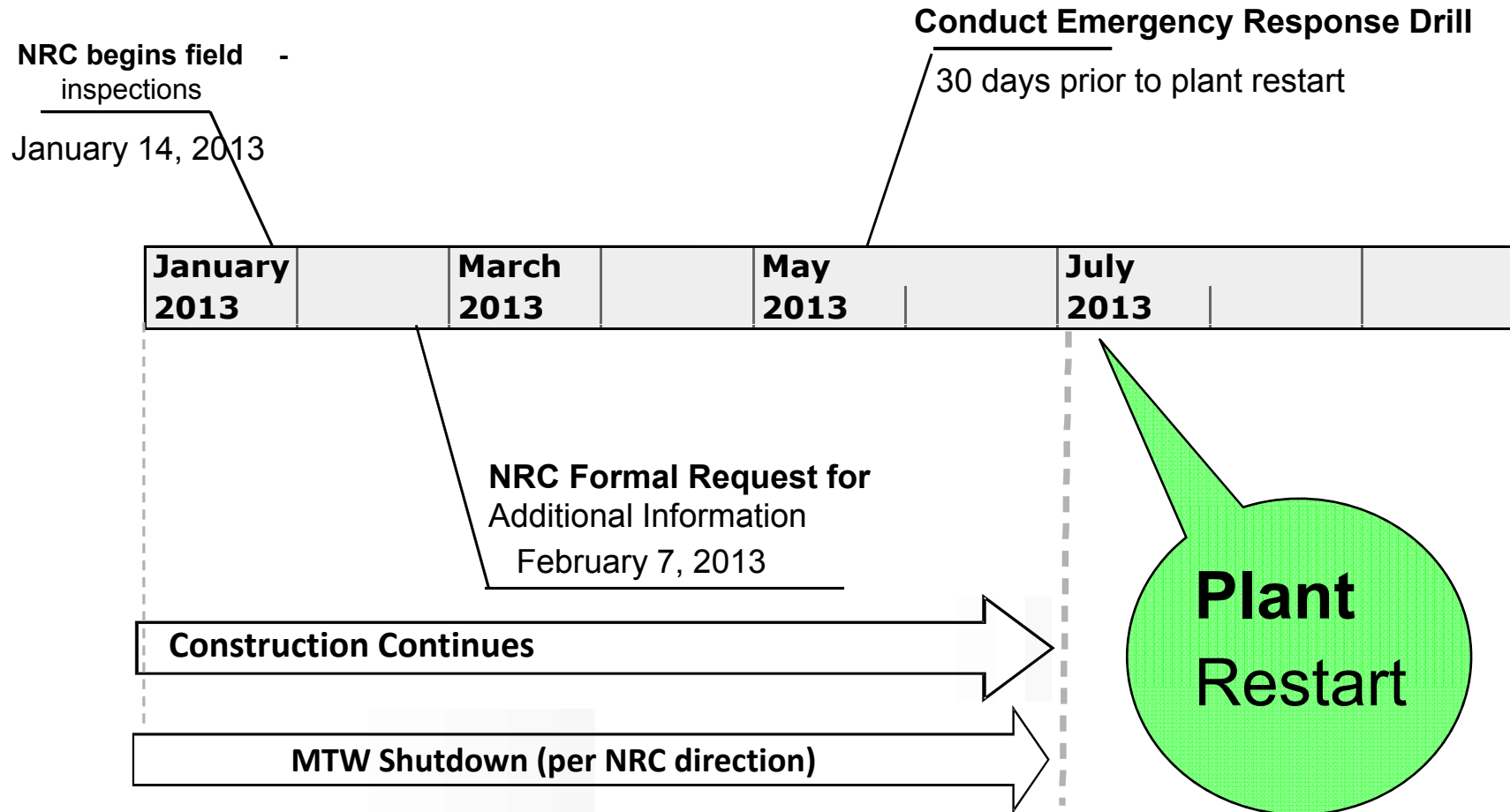
Production Ceased to Address NRC Findings

Timeline of Shutdown/Restart Activities



Focused efforts – Honeywell & NRC

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Focused efforts – Honeywell & NRC

Designing for Earthquakes

Comparative Earthquake Events				
PGA Peak Ground Acceleration (G)	Effect	Year	Location	
0.50	Severe Shaking, Moderate to Heavy Damage	1,000-Year MTW Event		
0.50		2010	Haiti	
0.44		1978	Miyagi, Japan	
0.37		2011	Lorca, Spain	
0.31	Very Strong Shaking, Moderate Damage	500-Year MTW Event		
0.30		1960	Valdivia, Chile	
0.24		2004	Morocco	
0.18		1964	Portage, AK, USA	

Peak Ground Acceleration (PGA) – measure of how hard the earth shakes – is key measure, not more common Richter Scale

Estimated size of New Madrid earthquakes in 1811-12, which are the most powerful earthquakes to hit the eastern U.S. in recorded history

- Design goal was to strengthen plant to maximum practical level
- Exceeds NRC license requirement – 475-year MTW event
- Ensures safety of plant personnel, community
- Models show design safe up to catastrophic area event

Safety Top Priority

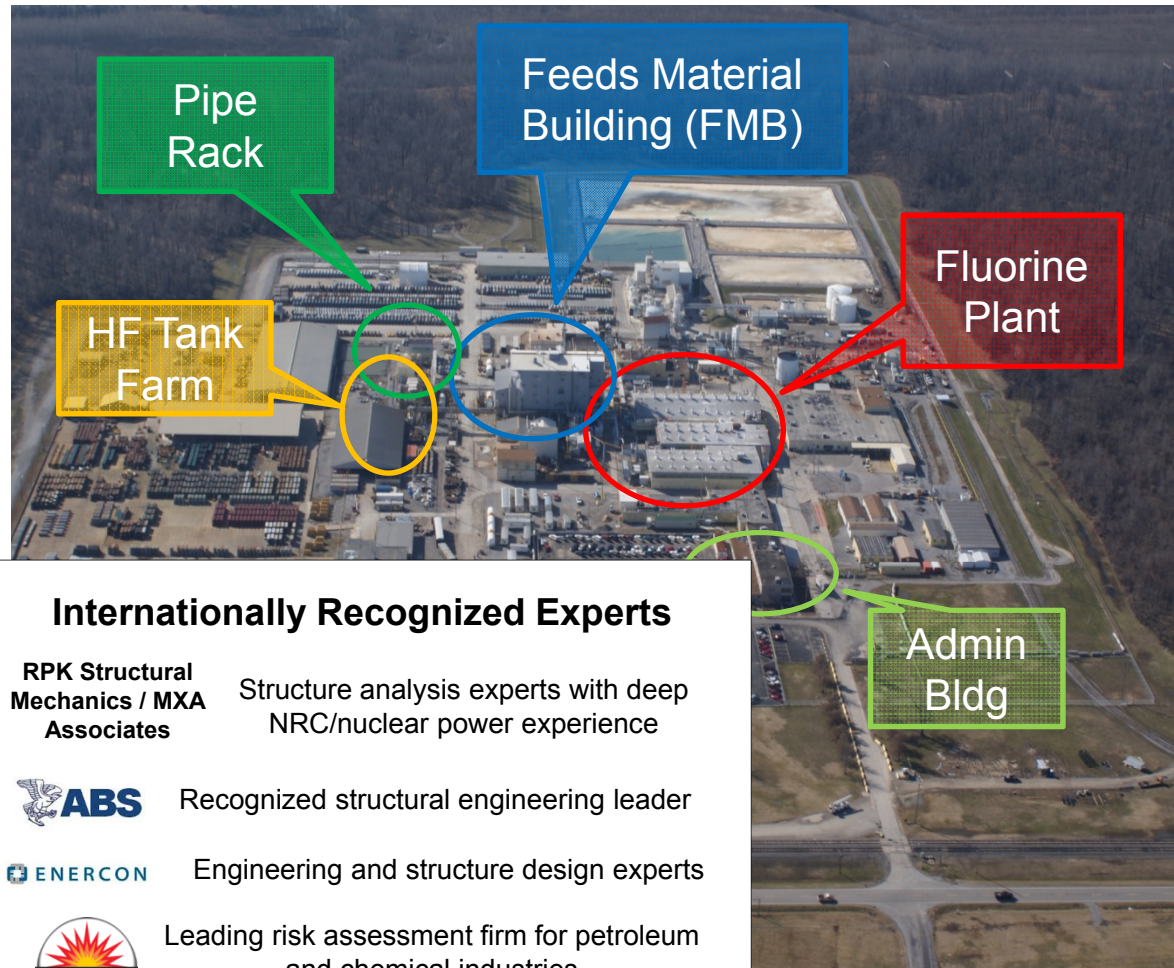
Upgrade Work

Capital Plan Objectives




Reduce risk to plant, employees and surrounding community by:

1. Strengthening key buildings and equipment against seismic risk
2. Reducing UF₆ release risks
3. Improving ability to withstand effects of strong tornados
4. Reducing volume of hydrofluoric acid (HF) on site
5. Improving emergency response plan and processes

Plant Upgrade Focus Areas



Internationally Recognized Experts

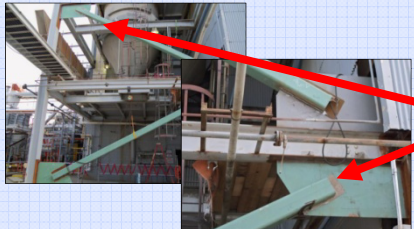
RPK Structural Mechanics / MXA Associates	Structure analysis experts with deep NRC/nuclear power experience
 ABS	Recognized structural engineering leader
 ENERCON	Engineering and structure design experts
 BAKER RISK	Leading risk assessment firm for petroleum and chemical industries

Reducing Potential Risk, Strengthening Assets

1. Strengthening Buildings/Equipment

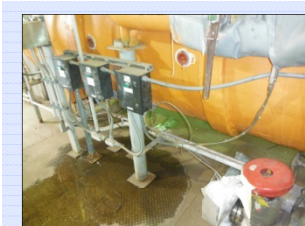
Feed Materials Building (FMB)

- FMB is main production facility for UF₆
- Six floors (plus basements) with processes; piping spans multiple floors



Structural improvements including new beams to harden building against seismic shock.

62 seismic valves and seismic controls added. Valves automatically close when seismic event is detected.



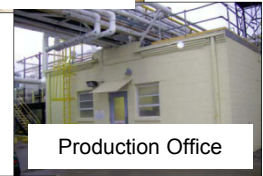
Restraints and bumpers added to process equipment.

Pipe supports hardened.

Piping, Other Buildings

Structural improvements to be made to “life safety” buildings including:

- Admin (security, surveillance and communication)
- Production office
- Lab, dispensary, health physics
- Boilerhouse
- Sample plant
- Maintenance area
- Fluorine plant



Strengthened extensive plant piping and walkways to withstand seismic forces.

Installed new lateral and vertical supports.

Comprehensive Approach for Key Areas

2. Reduce UF₆ Release Risks

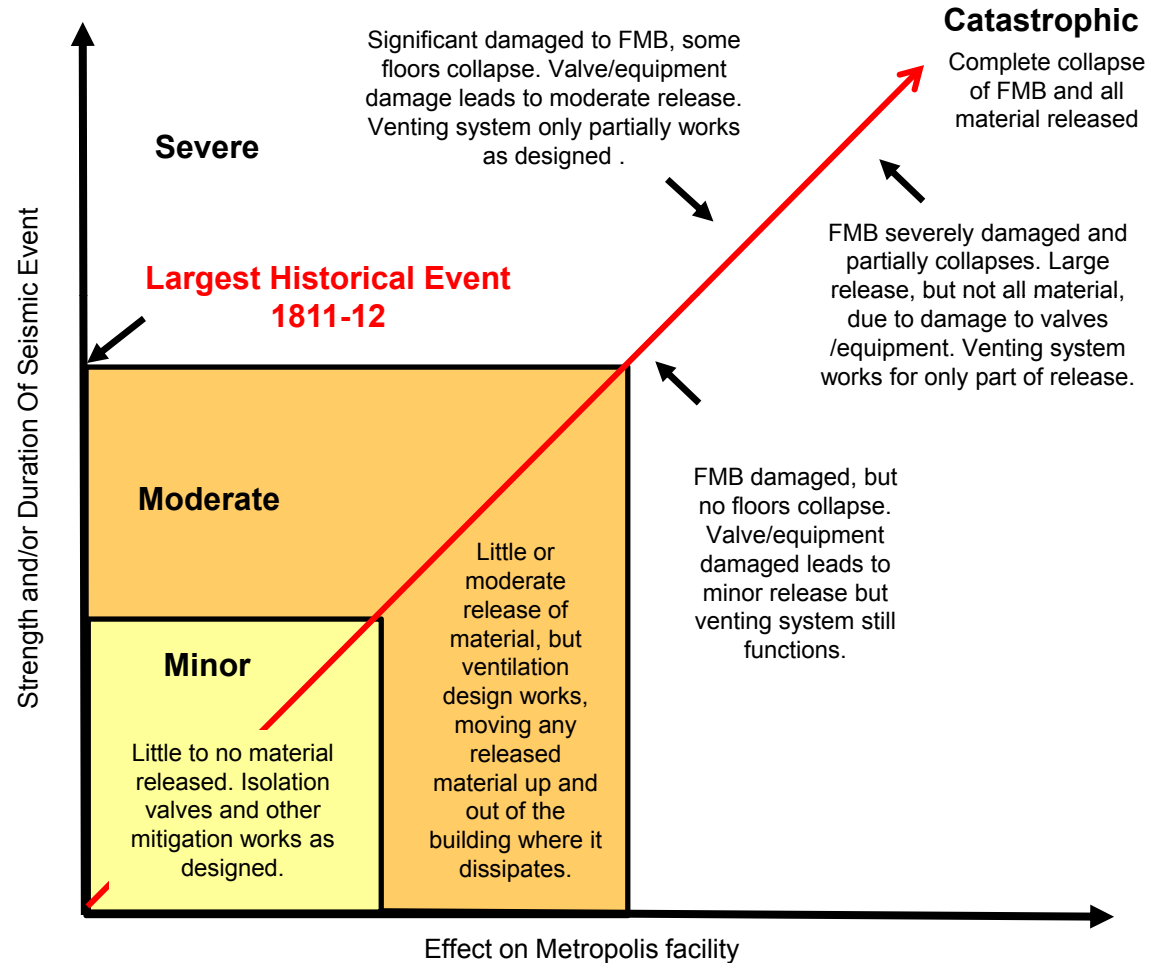
UF₆ Hazard

- Hazard comes from HF formation and exposure
- >206,000 lbs. of UF₆ could hydrolyze to >28,000 lbs of HF if sufficient moisture is present

Mitigation

- >60 isolation valves installed
- Strengthened building, piping, equipment
- Sealed distillation area to confine HF, then release at higher elevations
- HF released above three stories dissipates before getting to ground level
- Vent stack added for lower floors to move HF to higher elevation

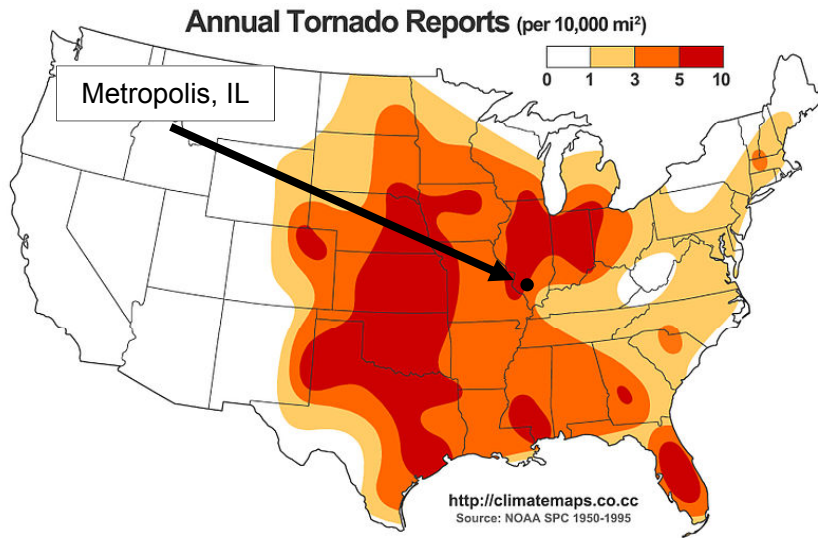
Release Scenarios



“Stack” Design Mitigates HF Exposure Risk

3. Tornado Hardening

Tornado Risk



- NRC views tornados risk based on Metropolis Works' location
- Threat primarily from debris, objects propelled by high winds
- Protection enhanced against telephone-pole size "missiles"

Mitigation

- Tornado preparedness procedures initiates process shutdown

- Added tornado shields for critical areas



- Installed guards, cages around key equipment and instruments
- Tornado winds help disperse materials

Risk of Wind-Driven Debris Mitigated

4. Reducing HF Risk

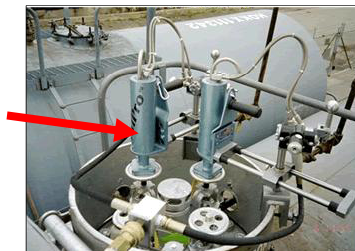
Prior Situation

- HF needed for conversion process is brought to site via railcar, offloaded into storage tanks, then sourced from tanks for processes
- Up to 430,000 lbs. of HF in tanks

New Approach

- HF to be sourced for processes directly from railcars as needed, eliminating use of tanks
- Added second HF offloading area

Quick shut-off valve on railcar activates automatically when seismic event detected by ground sensors at plant



Railcar Safer Alternative

- Railcars have thicker walls vs. storage tanks (1-1/32" vs. 1/2"); can handle 5x more pressure
- Designed to withstand start-stop stresses, roll-overs; plant installing tie-down systems to prevent roll-over during seismic event
- No additional railcars needed on site
- Reduces amount of HF stored on site to 170,000 lbs. (one railcar), which is far less than the prior situation



Oct. 2012 derailment in Kentucky, car left track and rolled over. No leak.



Feb. 2005 derailment near Pittsburgh. Two railcars derailed down hill. No leak.

Effectively Removing HF Seismic Risk

5. Emergency Preparedness

Lowered Hazard / Risk

- Significant reduction of hazards/risk on site through operational and design changes means no change to previous emergency plan radius
- Incorporating new procedures, requirements into employee training protocols, which include:
 - Regular emergency drills with NRC oversight
 - Strong relationships with emergency responders



Procedure Improvements

- Use administrative controls to minimize employee access to certain plant areas to reduce exposure risk
- Enhanced PPE requirements for distillation area; escape respirators required for FMB access
- Seismic/tornado hardening for shelter-in-place locations
- Ensuring internal emergency responders can handle events (because local responders would be dealing with earthquake damage elsewhere)



NRC Requires Plan to Result in No Adverse Impact

Honeywell – NRC Work process

- Focused on risk reduction....improvements to Emergency Response process (less risk = improved ERP)
- Iterative process to define “good enough” – specific criteria related to seismic requirements not well defined in Part 40 – focus on potential release scenarios, frequency, and consequences
- Communication between the NRC and HON regarding restart occurred often and were critical to the success of the project (e.g., regular project meetings, management interactions, timely inspections)
- The NRC made sure that agency resources were available to review restart plans
- Throughout the process, NRC retained their independence, technical competence, and transparency

Mutual goal = reduce risk to stakeholders

Summary

Honeywell

Plant Modifications

- Structural upgrades of building
- Equipment restraints tie equipment to building
- Seismic valves contain material in vessels
- Confinement provides for dispersion
- HF unloading directly from railcar reduces HF risk
- Tornado shields and cages protect from flying debris

Forward Plans

- Emergency Response plan matches risk profile of both UF6 and HF
- Management processes in place to maintain safety margin
 - Rigorous Management of Change process
 - Calculations monitor additions/deletions to weight in building
- Continue to make UF6 safely while protecting employees and the community

Safely making UF6 for the nuclear industry