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Modelling Gas Centrifuge Enrichment Plants

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Outline

1. GCEP Safeguards Regime
2. Building and Running the Model
3. Results and Conclusion

Standard GCEP Safeguards Goals

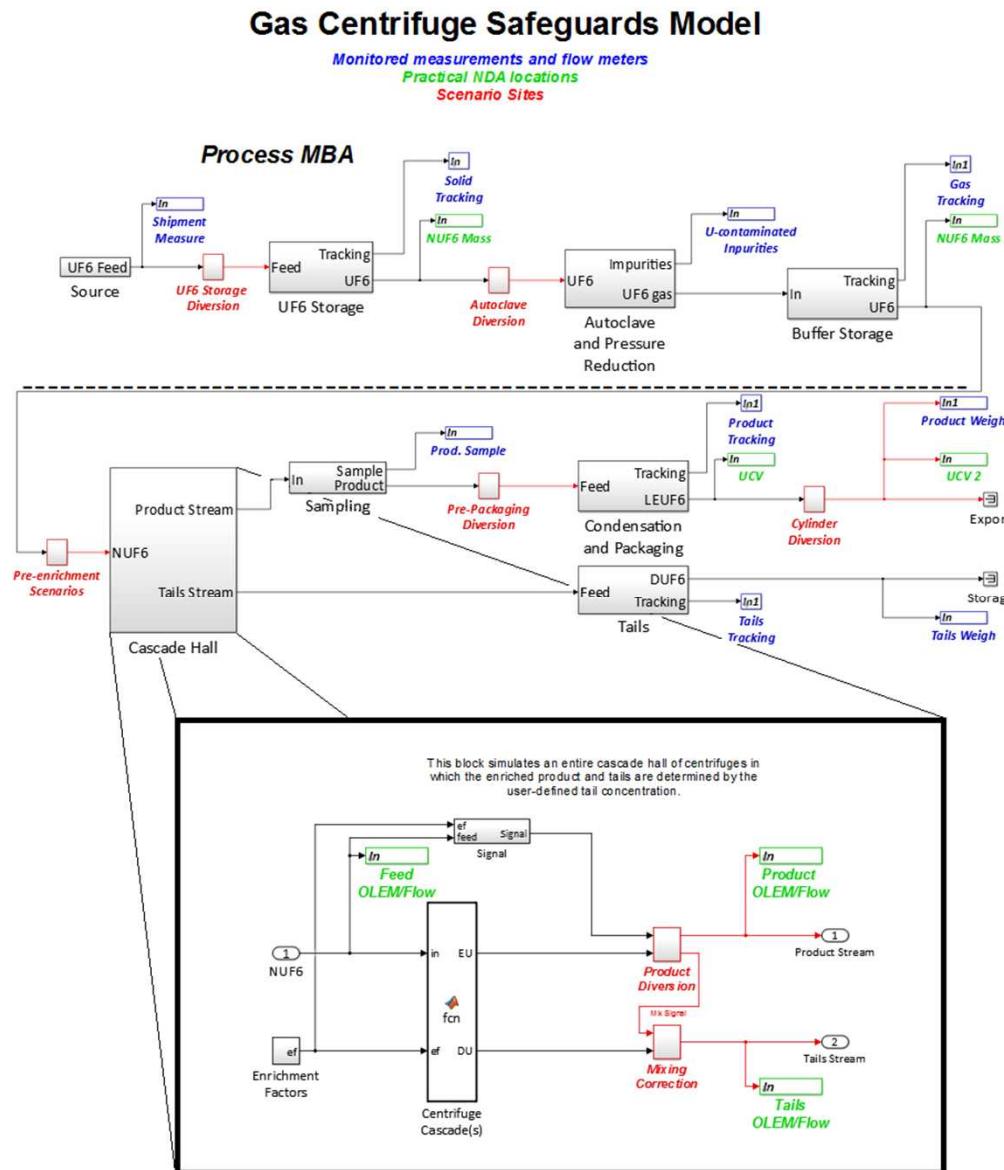
- Detect enrichment in excess of declared levels
- Hastily detect diversion of declared UF_6 production
- Detect undeclared UF_6 production
 - detect diversion of undeclared production, especially in the case of HEU

GCEP Safeguards Regime

- **Current IAEA Safeguards Techniques:**
 - Facility MBA reports
 - Inspections and sampling
 - Cameras, locks, and seals (C/S)
- **Recent Developments:**
 - NDA: Nondestructive Analysis
 - NRTA: Near Real Time Accountability

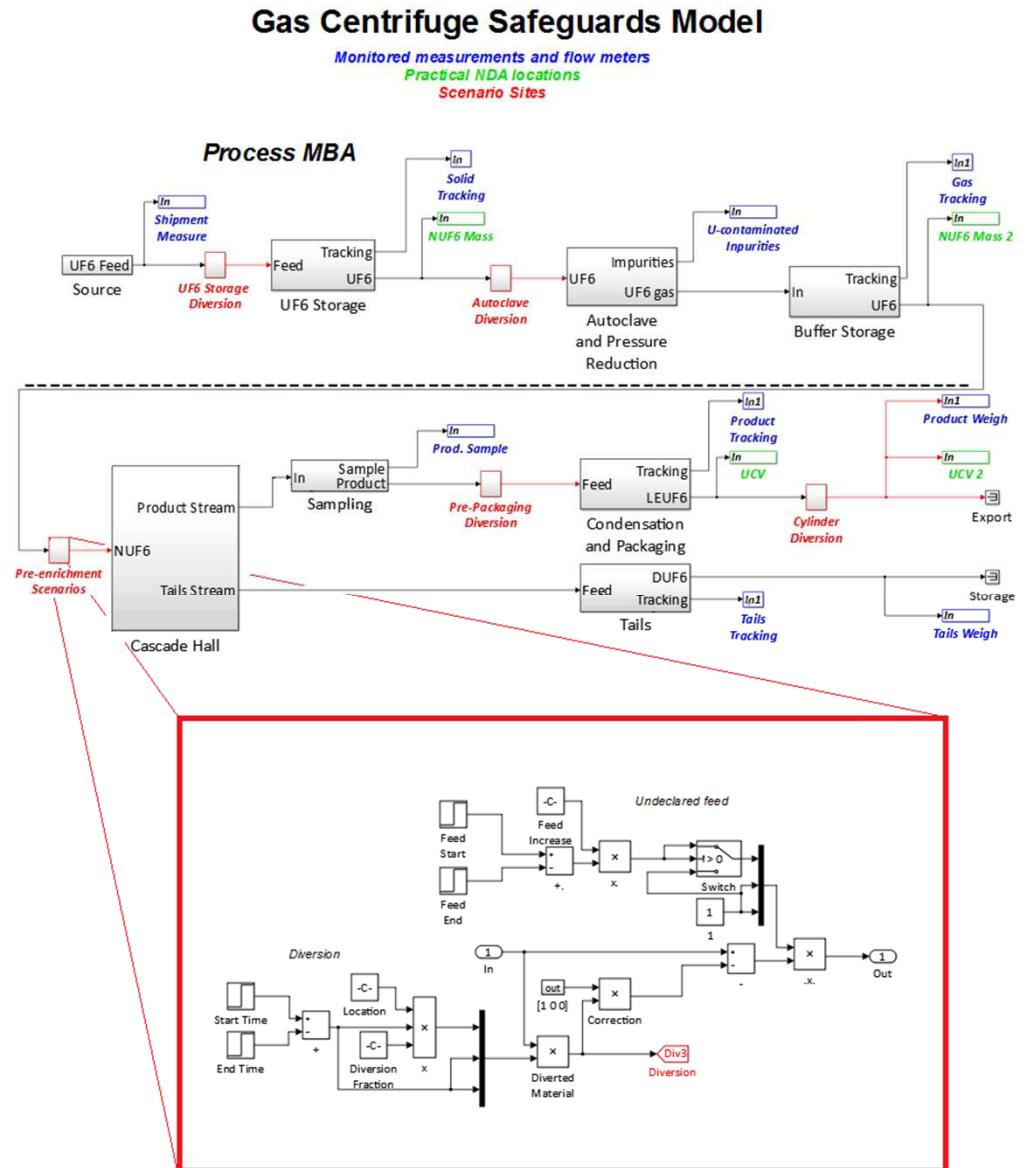
Building and Running the Model

- Basic GCEP stages:
 1. Incoming shipment
 2. UF_6 storage
 3. Autoclave conversion
 4. Buffer storage
 5. Cascade
 6. Sampling
 7. Condensation/Packaging
 8. Export and storage
- White blocks represent stages
- Realistic processes without specificity



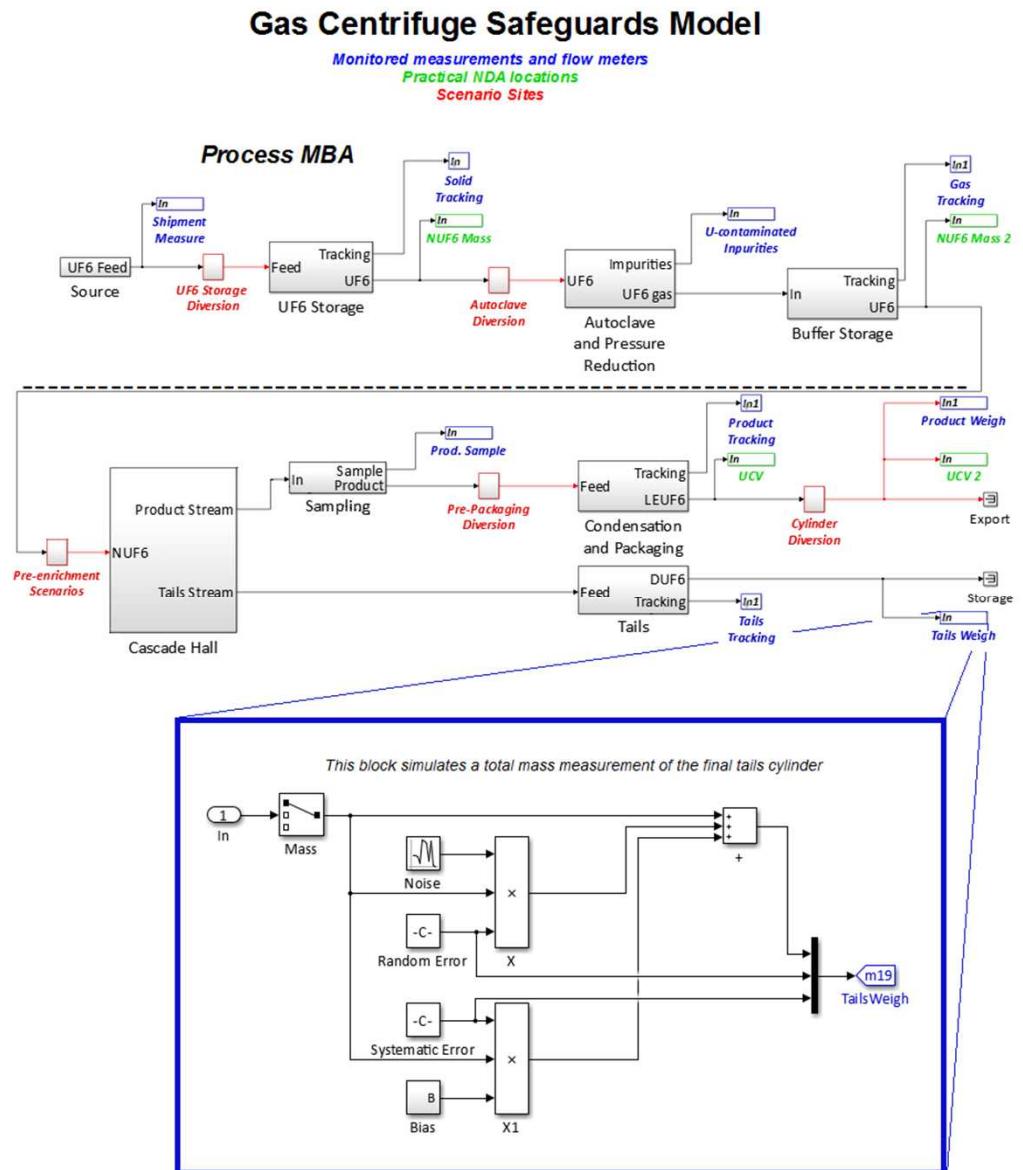
Building and Running the Model

- Malicious Scenarios:
 - Standard material diversion
 - Undeclared production increase
 - Discrete enrichment increase
 - Standard diversion with UF_6 mixing
- Violate different aspects of GCEP safeguards goals
- Potential locations indicated by red blocks

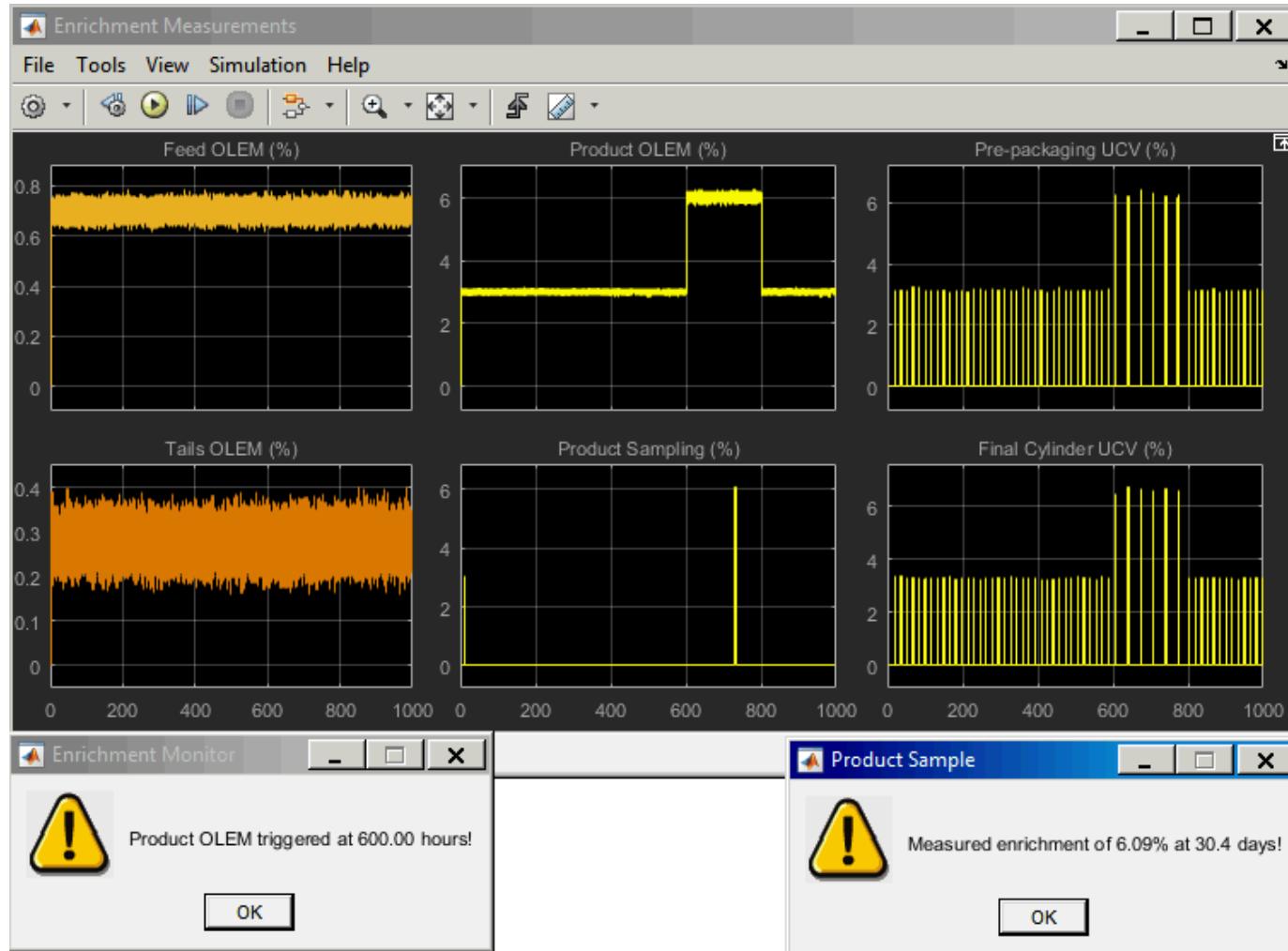


Building and Running the Model

- Potential NDA's in green and current attended measurements in blue
- Calculates inventory difference in various regions
- ID fed into a Page's Test to determine trend changes (+/- MUF)
- Establishes hard enrichment thresholds

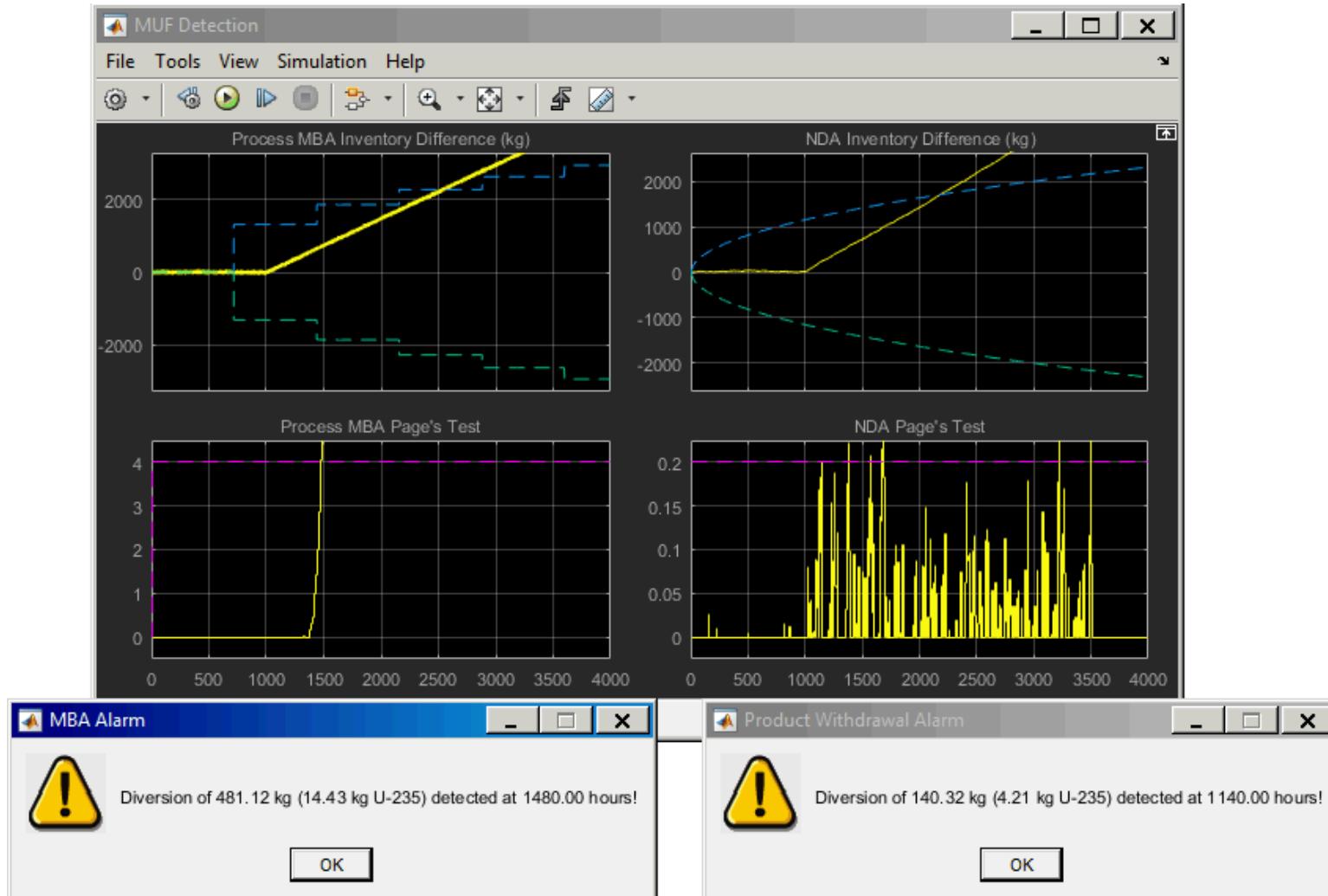


Building and Running the Model



- Discrete enrichment increase from 3% to 6% at 600 hours
- Detected by hypothetical OLEM and product sampling

Building and Running the Model



- 1% material skimming from 1000 - 3500 hrs. during product withdrawal
- Detected by hypothetical NDA and traditional MBA verification

Results and Conclusion

- Developed simple material flow and accountability simulation for generic GCEP's
- Definite potential for improvement and further development
- Experience provided practical experience in my field of study

Personal: Riley Carey



- Graduate student at Georgetown University
- Pursuing MS in Health Physics, BS in Physics
- Concentration in Nuclear Nonproliferation