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Sandia
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Modelling Gas Centrifuge Enrichment Plants

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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

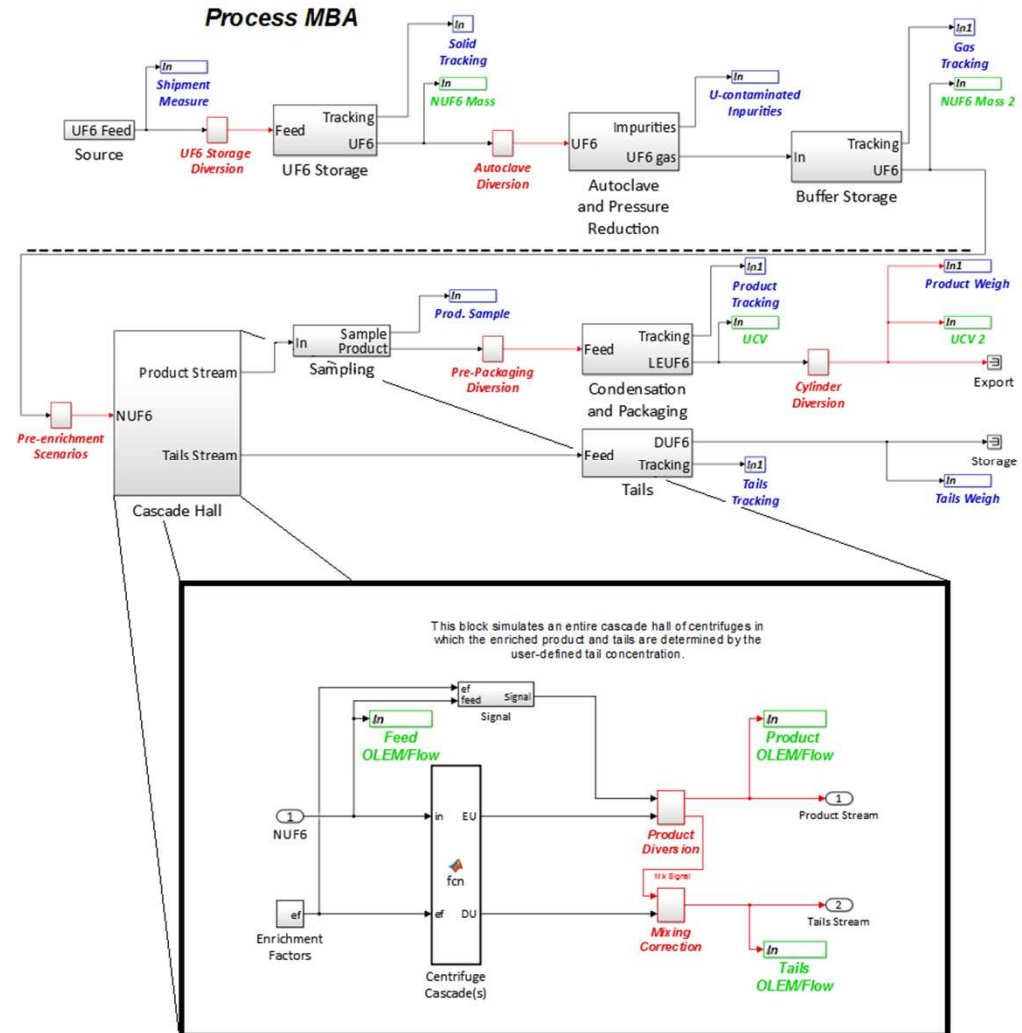
- **Current IAEA Safeguards Techniques:**
 - Facility MBA reports
 - Inspections and sampling
 - Cameras, locks, and seals (C/S)
- **Recent Developments:**
 - NDA: Nondestructive Analysis
 - NRTA: Near Real Time Accountability

Building and Running the Model

Gas Centrifuge Safeguards Model

Monitored measurements and flow meters
Practical NDA locations
Scenario Sites

- 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

Gas Centrifuge Safeguards Model

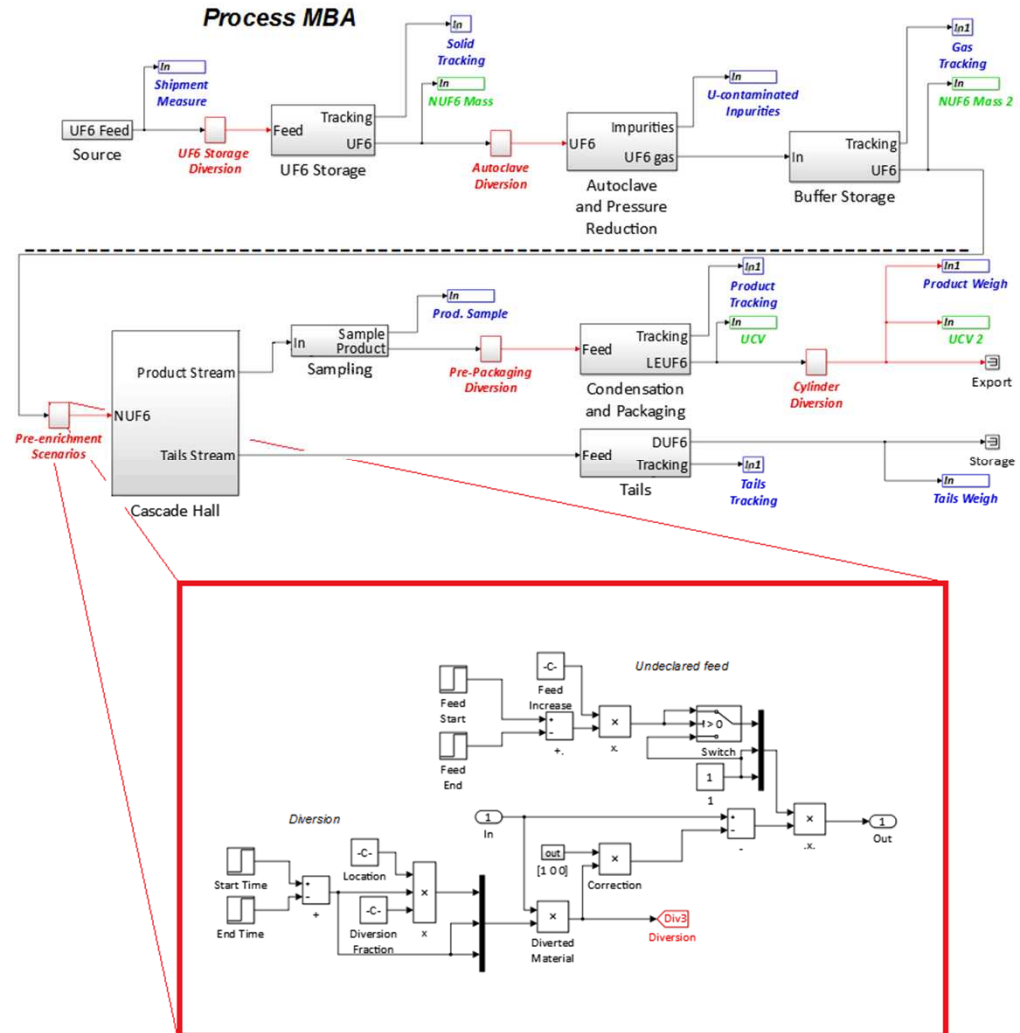
Monitored measurements and flow meters
Practical NDA locations
Scenario Sites

Malicious Scenarios:

- Standard material diversion
- Undeclared production increase
- Discrete enrichment increase
- Standard diversion with NUF_6 mixing

Violate different aspects of GCEP safeguards goals

Potential locations indicated by red blocks

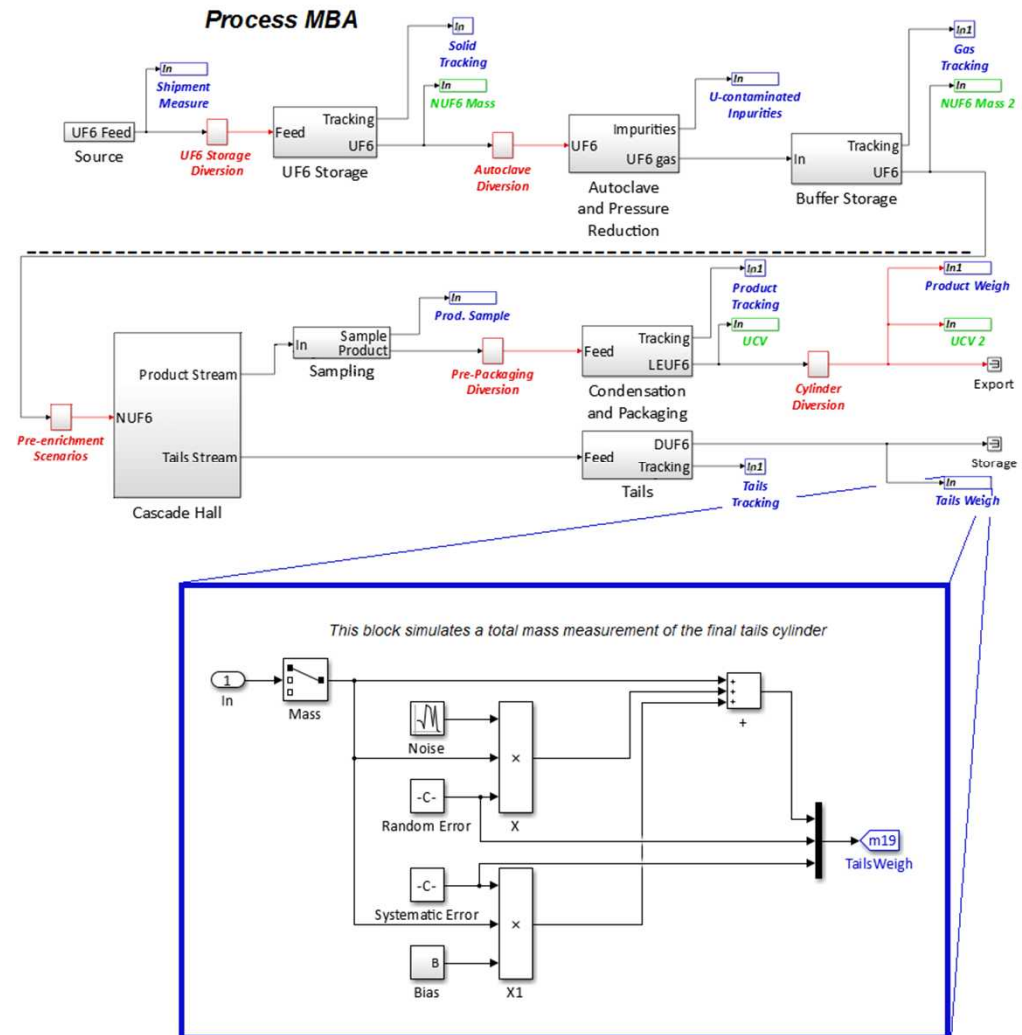


Building and Running the Model

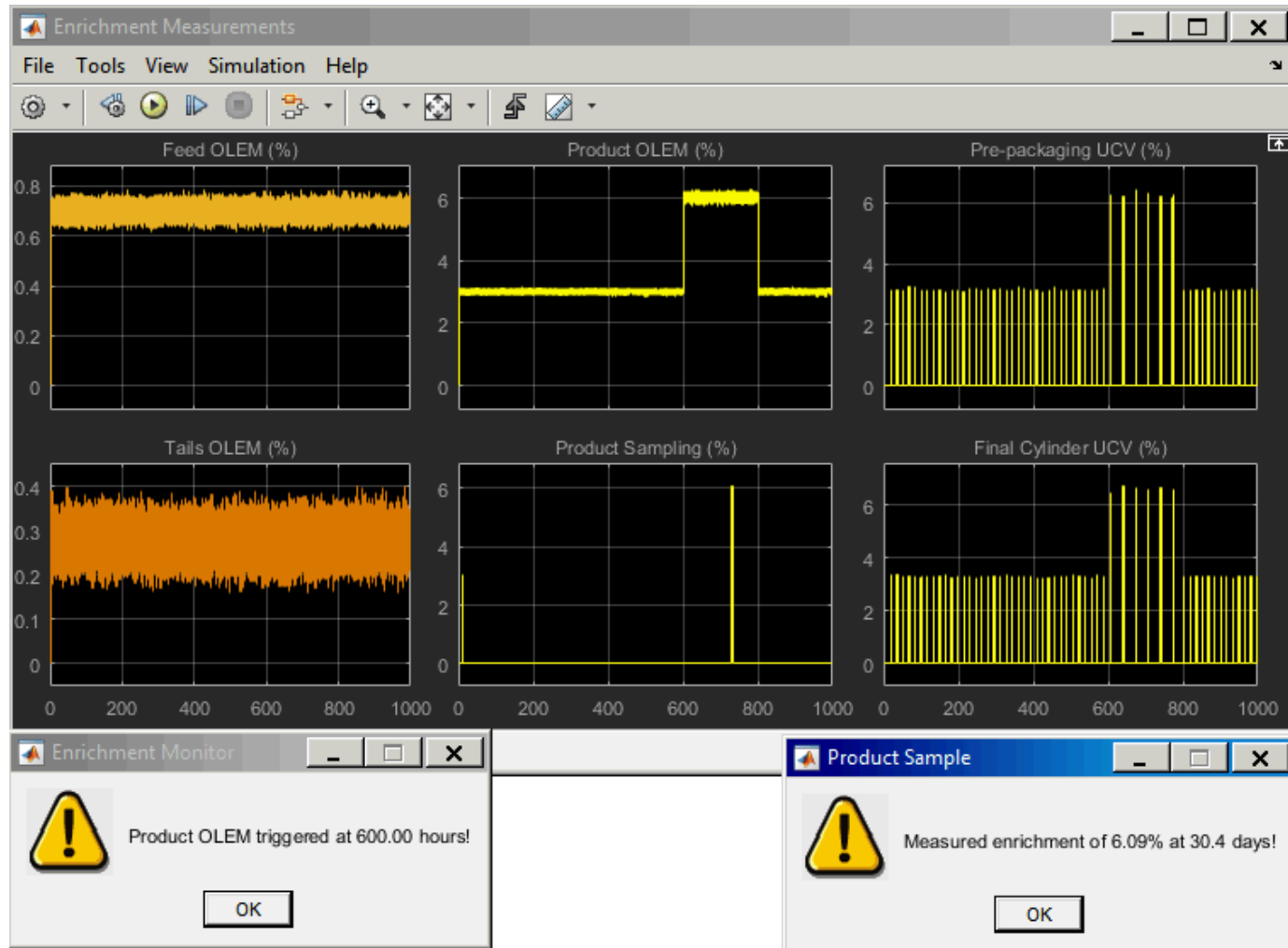
Gas Centrifuge Safeguards Model

Monitored measurements and flow meters
Practical NDA locations
Scenario Sites

- 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 (\pm MUF)
- Establishes hard enrichment thresholds

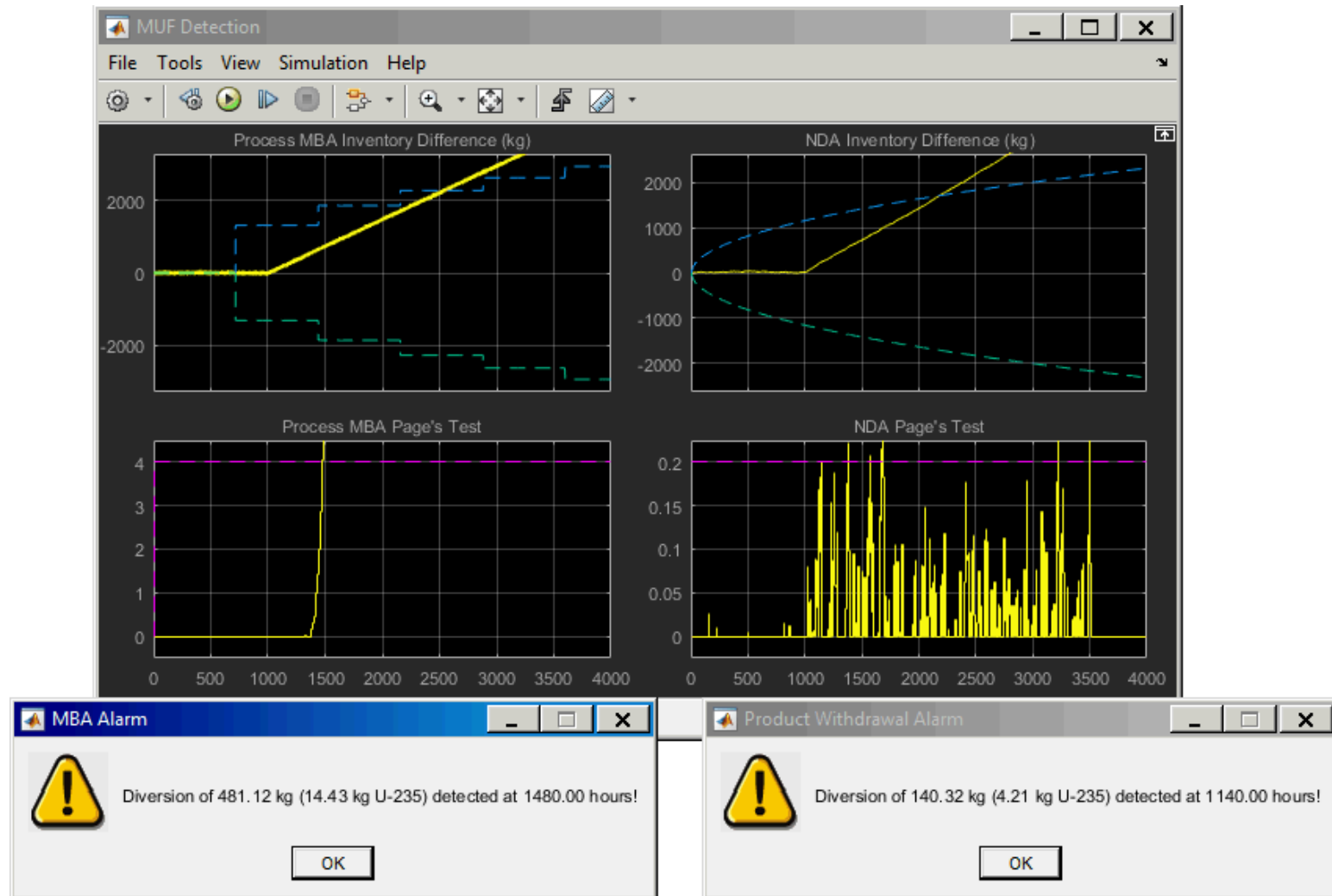


Building and Running the Model



- 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