Security Gaps Arising Due to Large Infrastructures Coupled with Energy Delivery Sub-systems

Gas and Electric Grid Unit Commitment with Coordinated N-1 Generator Contingency
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GOALS
- Operate both the gas and electric systems optimally, while respecting N-1 generator contingency requirements

FUNDAMENTAL QUESTIONS/CHALLENGES
- Critical infrastructures like the gas and electric systems are coupled.
- How does the operation technology (OT) of one affect the other?
- Could security breaches in one “spill-over” to the other?

GAS GRID MODEL
- The Gas grid is modeled with the following elements:
  - Pipes
  - Suppliers (wells/storage)
  - Loads
  - Compressors


RESULTS: NO COORDINATION VS. COORDINATION
- Solving the gas and electric systems separately (left) pressure violations occur.
  - This has also been shown in other works3
- Violations are avoided with the GECUC (right)

DISPATCH WITH NO COORDINATION
- Gas-Flow on 17-18 (m³,h⁻¹)
- Time (h)

DISPATCH WITH COORDINATION
- Gas-Flow on 17-18 (m³,h⁻¹)
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RESULTS: GENERATOR CONTINGENCY
- MILP formulation enables easy integration with N-1 contingency formulations.
- Compressor ratio is allowed to increase.
  - The fact that it does shows the benefit of considering the coupled problem
  - Certain cases could also cause infeasibility

FUTURE EFFORTS
- Example case demonstrating contingency infeasibility if compressors are not handled correctly.
- Develop ways to decompose the optimization problem.

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