DEVELOPMENT OF A FRAMEWORK FOR SYSTEM-LEVEL CARBON SEQUESTRATION RISK ASSESSMENT

NETL Project Agreement DE-FE0001164

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Presentation Outline

- Introduction to GoldSim
- Project Goals
- Technical Status
  - Injection & Release Risk Analysis
  - Comparison of Scenarios
  - Programmatic Risk Analysis
  - Process Flow Risk Analysis
- Summary

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Benefit to the Program

- This project is developing an enhanced computational platform for predictions of storage capacity and storage system performance. This will be of value for project design, permitting, financing, and insurance.

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Project Overview:
Goals and Objectives

- Enhance GoldSim in Four Phases:

  1. Simulation of CO_2 Injection & Release Risks.

  2. Comparison of Alternative Scenarios and Approaches.

  3. Modeling of Programmatic Risk.

  4. Modeling of Process Flows & Associated Risks.

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What is GoldSim?

- A Windows-based program for carrying out dynamic, probabilistic simulations of complex systems.

- GoldSim's origins were in long-term safety assessment of radioactive waste repositories.

- GoldSim Technology Group is a small business that focuses on developing and supporting the GoldSim software.

- Most of our clients are government agencies and consultants, over 50% are international.

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How is GoldSim Used?

- Applications are very wide-ranging: environmental, engineering, business...
- Most applications are strategic rather than tactical
  - Ask the "big picture" questions.
- Most simulations have long time frames.
- Complex "total system" models.
- Many applications are high profile (high cost, high consequence).

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Use of GoldSim for CCS Studies

- LANL (CO_2-PENS):
  - NRAP leakage calculations.
  - E&ES paper with southeast models, 2012
  - IJGGC paper re reservoir uncertainty, 2012
  - ES&T paper oil shale systems analysis, 2011
  - Rock Springs Uplift study, 2010
  - DOE HQ screening model
- LBNL
- UK (Quintessa)
- Alberta (Golder Assoc.)

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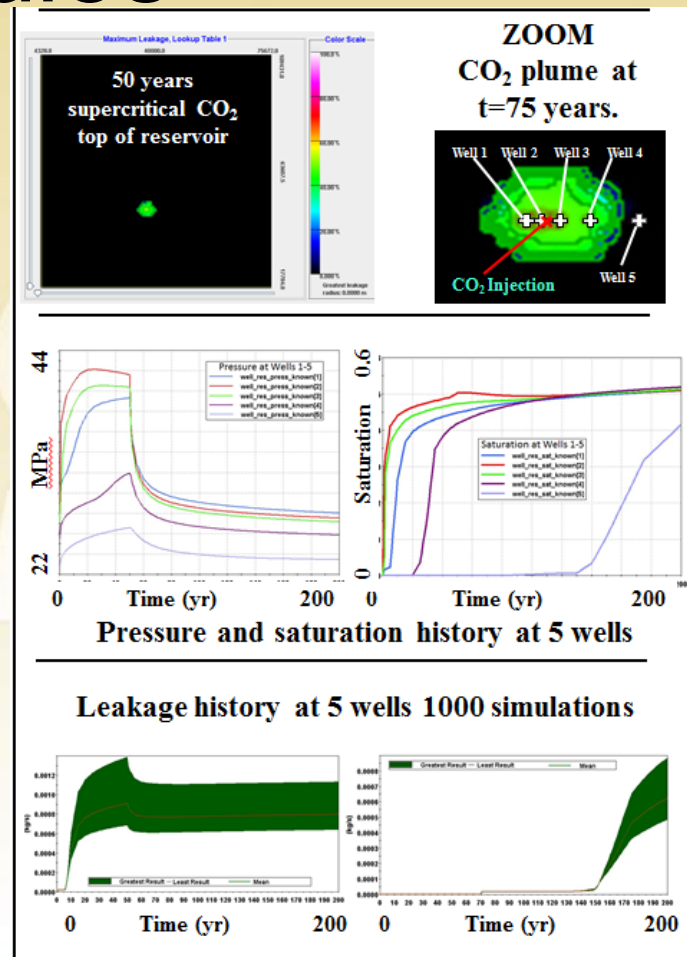
Technical Status: Simulation of Injection & Release Risks

- New scripting language capability.

- Enhanced spreadsheet integration.

- Enhanced array processing logic.

- Enhanced input of time series data, lookup tables, probability distributions, etc.

- Enhanced control over model calculational sequence.

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Technical Status: Comparison of Alternative Scenarios/Designs

- Completed a major effort to support:
  - User definition of alternative scenarios
  - Simulate each scenario
  - Capture and present results 'side by side'.

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Programmatic Risk Analysis

- Simulation of projects:
    - Project costs, revenues, schedule.
    - Project risks (permits, financial, technical, social, short and long-term…)
    - Project decisions based on new information.
- Used by project owner, financers, insurers.
- This is the 'big picture': technical risk is just an input to it.

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Technical Status:
Programmatic Risk Analysis

- Enhanced simulation of projects:
  - Project decisions based on new information (Bayesian updating).
  - Risk analysis for project milestones.
  - Enhanced support for calendar-based modeling.
- Multiattribute Decision Analysis capability developed.

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Multiattribute Decision Analysis

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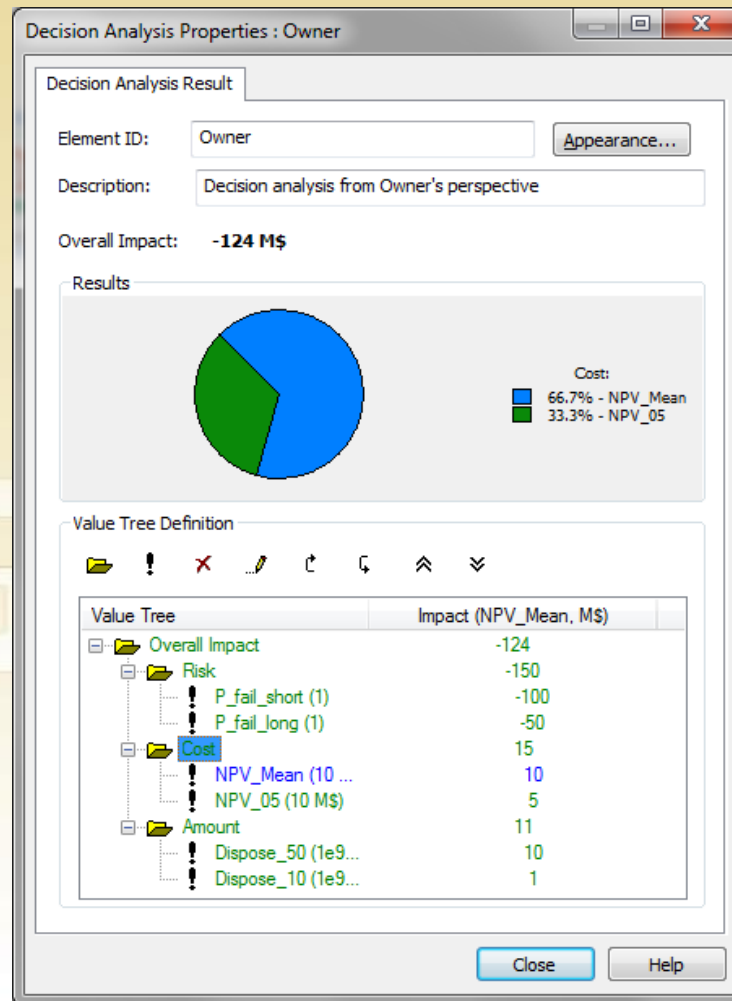
Technical Status:
Modeling of Process Flow Risk

- Simulate storage, processing, and transport components of CCS system:
  - Pipelines, injection sites, storage and compression/refrigeration sites.

- Develop improved capabilities to simulate equipment reliability and impacts of potential problems.

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Process Flow Test Model

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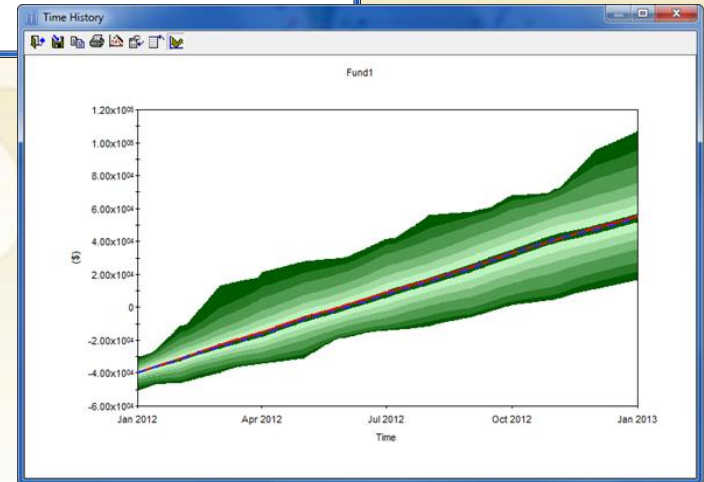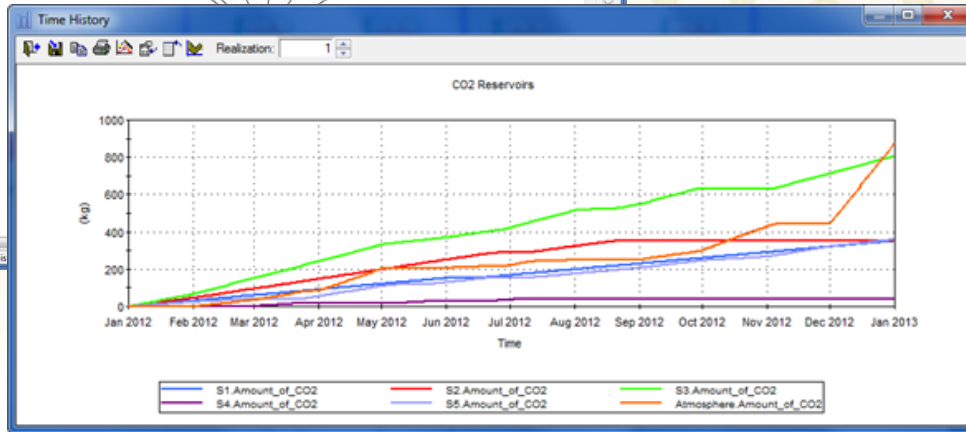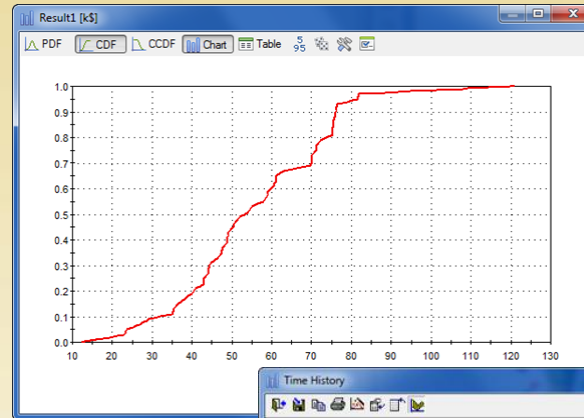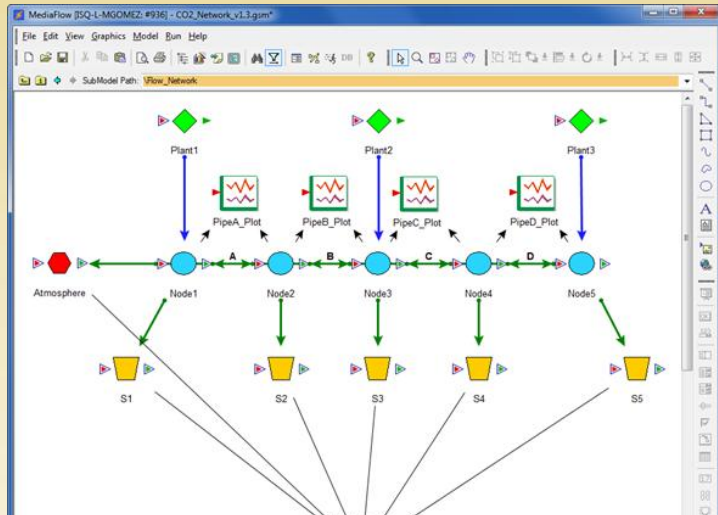
Accomplishments to Date

- Enhanced support for technical risk analysis.

- Enhanced support for CO_2 network risk analysis.

- Enhanced support for overall project risk analysis.

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Summary

- Key Findings: N/A.

- Lesson Learned:
    - S/W development is never easy!

- Future Plans:
  - Project is nearly completed.
  - New version to be released this fall.
  - Ready to do a 'big picture' project risk model.
  - Please contact the author if interested in applying it.

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Appendix

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Organization Chart

- The Principal Investigator for the project is Mr. Ian Miller of GoldSim Technology Group LLC. Mr. Miller is responsible for all project tasks, and coordinates directly with the DOE Sponsor.

- Reporting to Mr. Miller within GoldSim is Mr. Stefan Knopf, Chief Programmer of GoldSim Technology Group LLC, who has overall responsibility for the software development activities and who directs software development and testing activities. Also reporting to Mr. Miller is Mr. Rick Kossik, the deputy P.I. who is also responsible for quality assurance and documentation.

- Coordinating the Los Alamos National Laboratory contribution is Dr. Phil Stauffer. Dr. Stauffer coordinates LANL's activities during development of the Requirements Documents for each of the four development stages, and also the LANL activities as each component is tested.

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Gantt Chart

Project Duration - Start: October 1, 2009 End: July 31, 2012

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Bibliography

- No peer-reviewed publications have been produced.

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