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Development of a Nearly Autonomous Management and Control (NAMAC) System for Advanced Reactors

Team members

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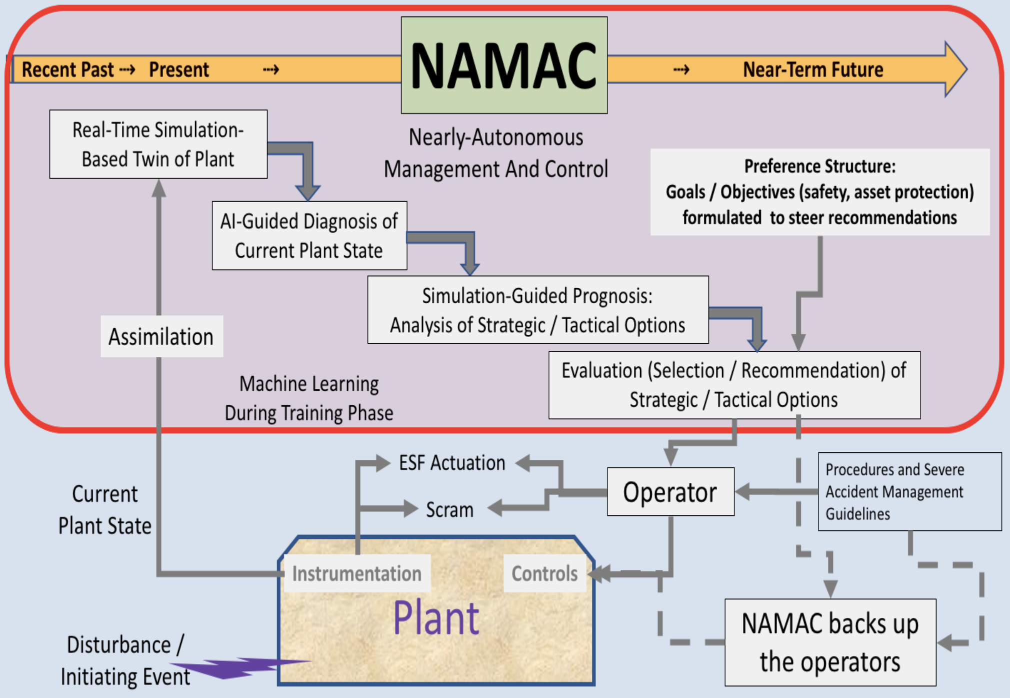
What is the technology?

A comprehensive, data/knowledge-driven, AI-based control system for credible, consistent management of plant operations to improve safety and performance in advanced reactors based on :

- *Comprehensive scenario-based model of plant (systems, success paths).*
- *Digital-twin technology to keep track plant operational history while continuously assimilating current-plant-state data in ongoing simulation of plant behavior.*
- *Advanced algorithms in machine learning for effective search and optimization.*

Goal

Provide recommendation to the operator during all modes of plant operation: plant evolution ranging from normal operation to accident management (including DBA, BDBA, severe accidents and multi-hazard external events).



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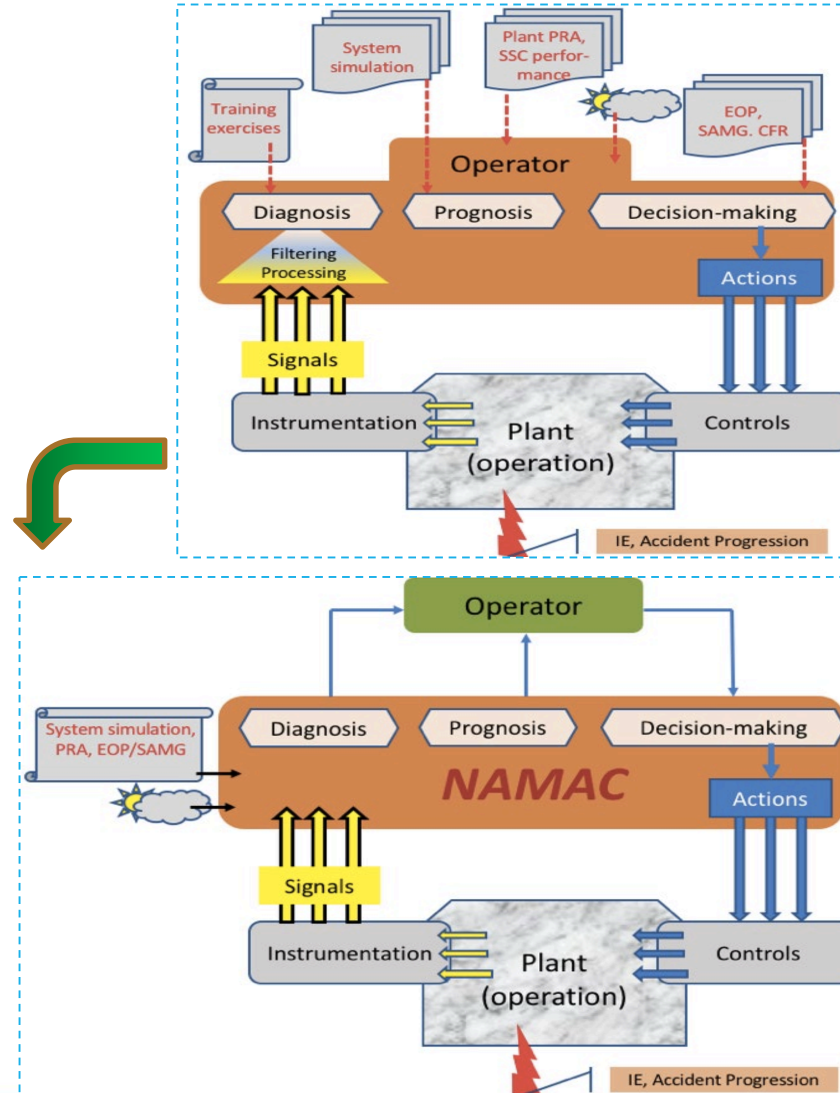
How is your system transformational?

- *Transition from operator-centric plant control architecture to NAMAC-enabled plant control architecture*
- *NAMAC diagnoses the plant state, projects the effects of actions and uncertainties into the future behavior and determine the best strategy to cope any situation with respect to the plant safety, performance, and cost.*
- *NAMAC enables a smaller operational staff to manage the plant better than any human(s) currently can, assisted only by instrumentation, operator training, and procedures.*
- *NAMAC system implementation has potential to affect the plant risk profile (with implications for system design, SSC and EPZ) through reducing operator errors, and promoting dynamic and effective management of abnormal transient and accident scenarios.*



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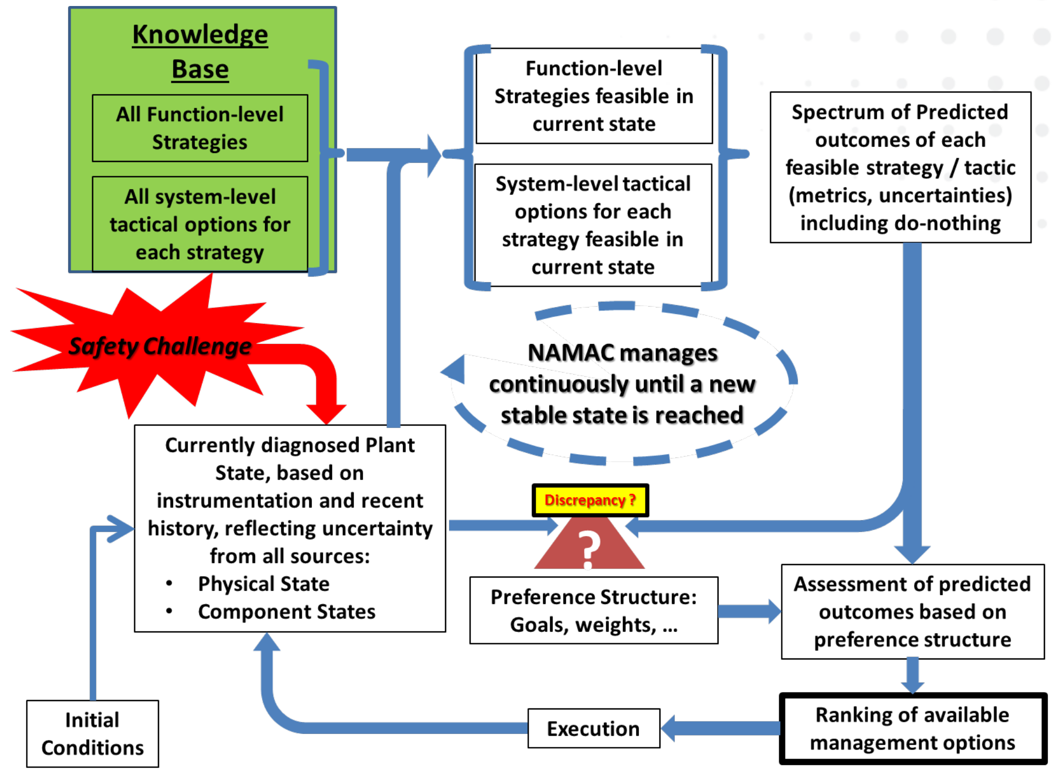
What challenges do you anticipate?

- *Theoretically and computationally, the task boils down to solving complex and demanding problems of diagnostic planning.*
- *The complexity stems from having to deal with a large amount of data (including their heterogeneity, multi-physics simulation results, real-time plant conditions, and measuring systems' (un-)reliability all with disparate length and time scales), a range of possible actions and uncertain high-consequence outcomes.*
- *Very deep knowledge of plant behavior, at different time scales, is required to make NAMAC work.*
- *The proposed approach makes aggressive use of simulation, data assimilation, and machine learning.*



- *Project performance depends on successful implementation of computational algorithms for three key functional components: (i) Diagnostics/Mapping; (ii) Exploration/Forecasting; and (iii) Choice/Decision.*

arpa·e CHANGING WHAT'S POSSIBLE