

Introduction to EPRI Advanced Nuclear Technology Program

Andrew Sowder, PhD, CHP – Senior Technical Executive
Jeremy Shook, PE, PMP – Principal Technical Leader

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Advanced Reactors are Here



In this decade...

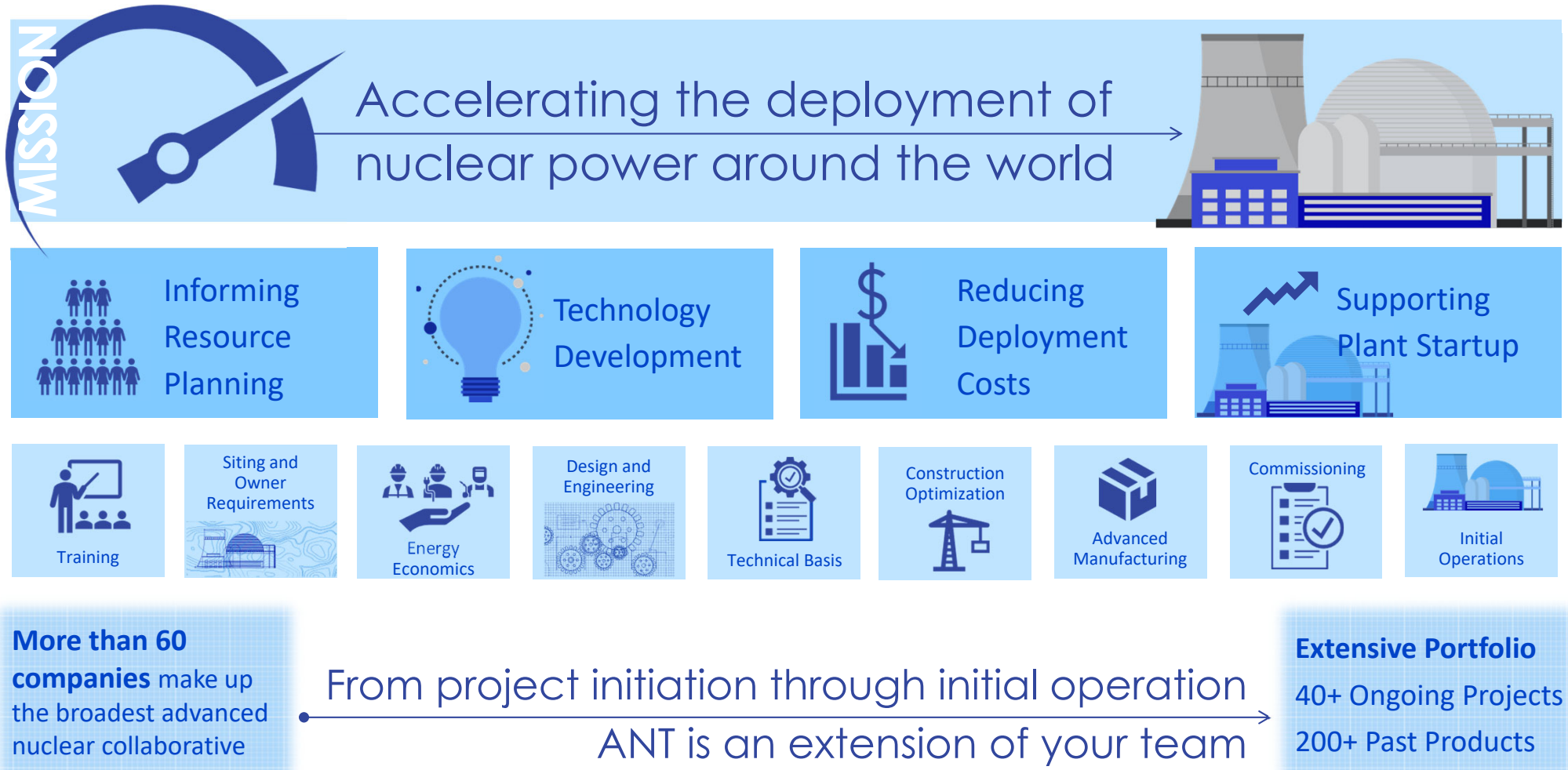
- Microreactors
- Non-light water reactors
- Light-water small modular reactors

... will be deployed



THE TIME TO PREPARE FOR AN ADVANCED REACTOR FUTURE IS NOW

Advanced Nuclear Technology (ANT) Program Focus



ANT Team and Advisory Structure

THE EPRI TEAM



- **Craig Stover**
Program Manager



- **Robin Thompson**
Technical Assistant



- **Andrew Sowder**
Senior Technical Executive



- **Hasan Charkas**
Principal Technical Leader



- **Jeremy Shook**
Principal Technical Leader

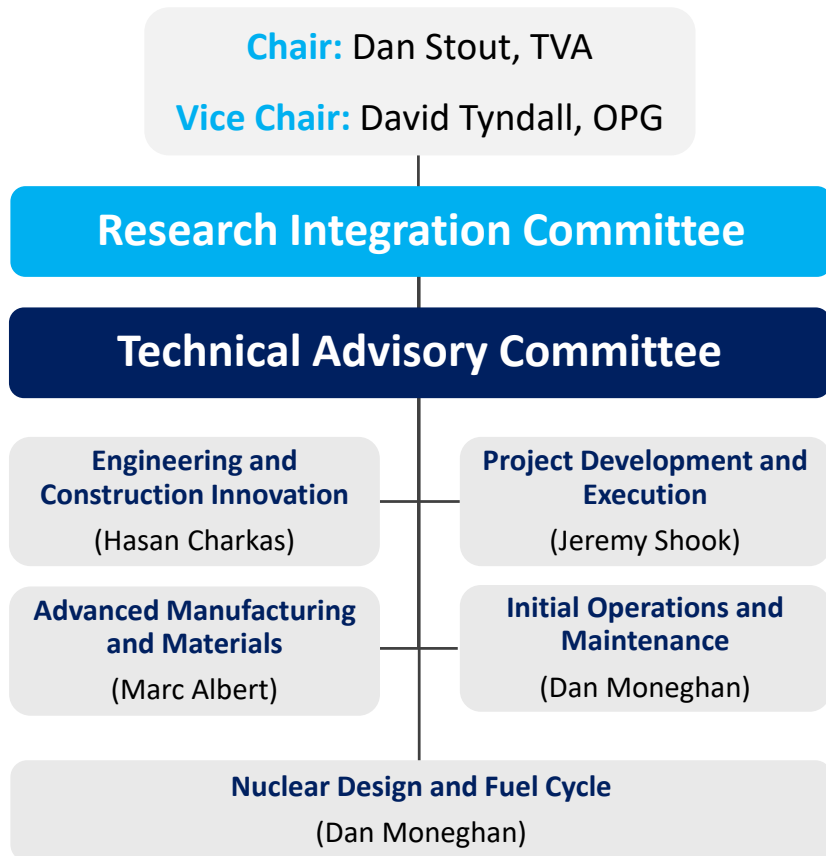


- **Marc Albert**
Senior Technical Leader



- **Dan Moneghan**
Engineer/Scientist III

ADVISORY STRUCTURE



Proposed 2022 ANT Membership

ANT Participation Extended to Over 60 Companies

NEW FOR 2022 - NUCLEAR SECTOR BASE MEMBERS

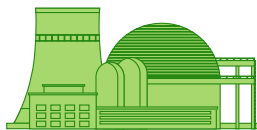


22

US Members

24

International Members



>77%

of the world's commercial nuclear units



>340

reactors worldwide

FULL ANT SUPPLEMENTAL MEMBERS



FLUOR



HITACHI



NUCLEAR AMRC



Rolls-Royce



ADVANCED REACTOR INITIATIVE MEMBERS



NEIL



Studsvik



ULTRA

ANT's Research Portfolio

STARTUP & OPERATIONS

60+ Documents



SEISMIC & PLANNING

20+ Documents



FABRICATION & PROCUREMENT

40+ Documents



DESIGN

70+ Documents



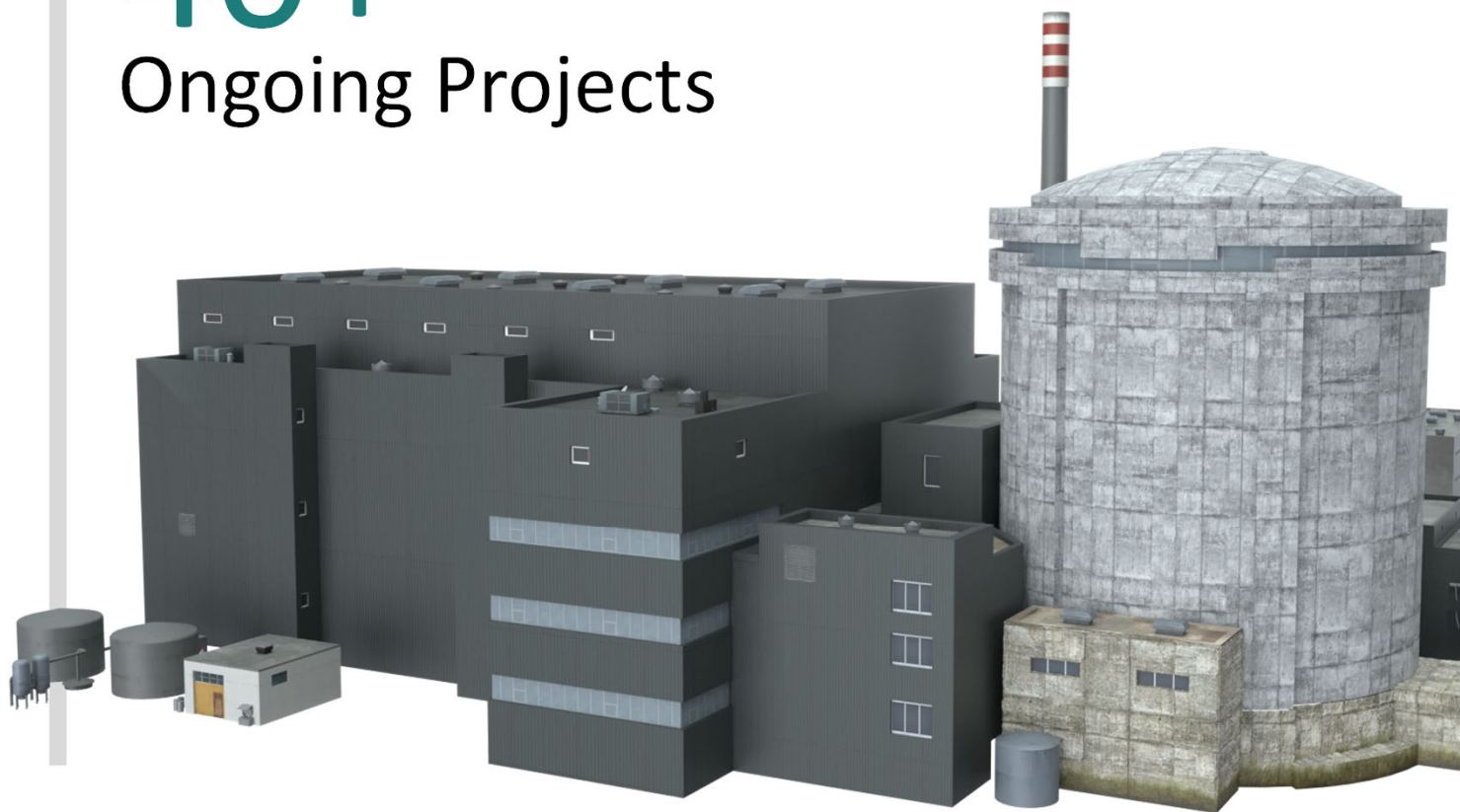
CONSTRUCTION

70+ Documents



40+

Ongoing Projects



A sample of EPRI Products to Reduce Deployment Cost

Total Potential Savings from Top 5 Cost Drivers: ~\$3000/kWe (From: 3002015935)

Potential Savings (\$/kWe)



Cost Drivers

*Ongoing

ANT Initiatives

Innovative Construction Technologies

- Seismic Base Isolation
- Digital Twins
- Faster construction disposition
- Modularization



Lifecycle Digital Engineering



- Model-based systems engineering assessment
- Fully-integrated **digital execution environment**

Autonomous Advanced Reactor

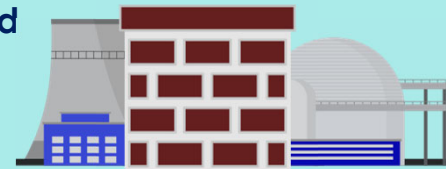


- Optimize **staff** while improving **safety** and **reliability**
- Leverage **sensors**, **drones**, and **robotics**
- Efficient path to **retrofit**, while designing for the **future**

Decoupling NI & BOP

Develop technical basis to **decouple nuclear island** from balance of plant

Reduce quality creep to reduce cost



Advanced Manufacturing

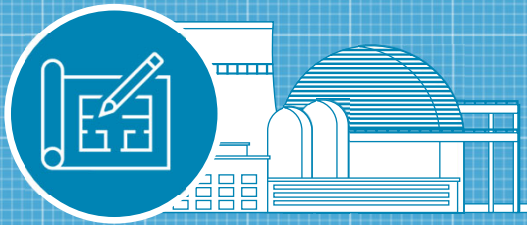


EPRI is working to
RE-INVENT
the nuclear supply chain

EPRI | ELECTRIC POWER
RESEARCH INSTITUTE

ANT New Plant Technical Assistance

EPRI Technology Transfer



Project Initiation

New to Nuclear Training

- ✓ Siting
- ✓ Utility & Owner Requirements
- ✓ Design



Pre-Construction

Construction Readiness Review

- ✓ Engineering
- ✓ Optimization
- ✓ Advanced Manufacturing



Commissioning & Initial Operations

Technical Readiness Review

- ✓ EPRI Program Implementation
- ✓ Startup and Testing

2021 Advanced Nuclear Technology Calendar

	Meeting	Date	Location
ANT	GAIN-EPRI-NEI Advanced Reactor Safeguards and Security Workshop	April 13-15	Virtual
	Project Ideation Summary	April 23	Video/Email
ANT ADVISORY MEETING	AR Supplemental Committee Prioritization Meeting	April 27	Virtual
	GAIN-EPRI-NEI Microreactor Workshop (hosted by DOE/GAIN)	May 12-13	Virtual
	EPRI Fusion Forum: Focus on Collaboration / Introduction to EPRI / Poll on General Gaps	May 20	Virtual
FUSION	Workshop on Instrumentation & Control Research Needs for Advanced Reactors	June 1	Virtual
	TAC Prioritization – RFAs with Candidate Projects Sent by Survey	Week of June 7	Email
	TAC Webcast – Overview of Candidate Projects	June 9	Virtual
	AR Initiative Meeting: Safety - in - Design	June 17	Virtual
	TAC Prioritization – Survey Input Due	June 25	Survey/Email
	EPRI-NEI Advanced Reactor Materials Development Workshop	June 29	Virtual
	EPRI Fusion Forum: July 15, 2021	July 15	Virtual
	Prioritization Results and Draft Portfolio Summary	July 30	Video/Email
	AR Initiative Meeting: Standard Cost Model Project Update	August 19	Virtual
	Summer RIC Meeting – Plan Focused, Portfolio Endorsed	Week of August 23	Virtual
	GAIN-EPRI-NEI Advanced Methods for Manufacturing – Qualification Workshop (hosted by DOE/GAIN)	August 24-26	Virtual
	CATF-EPRI-Pillsbury Virtual Workshop: Nuclear for Marine Shipping	September 9	Virtual
	EPRI Fusion Forum: Technology Overview: Fusion Developer TBD / EPRI Technology Overview: Topic 2	September 23	Virtual
	AR Stakeholder Forum (Public)	October 26	Virtual
	AR Supplemental Committee Meeting	October 27	Virtual
	Extended Storage Collaboration Program (ESCP) – Advanced Reactor Workshop	November 8	Virtual
	EPRI Fusion Forum: Technology Overview: Fusion Developer TBD / EPRI Technology Overview: Topic 3	November 18	Virtual
	AR Initiative Meeting – Project Updates: AR Degradation Mechanisms; High Temperature Concrete	December 2	Virtual

Engineering and Construction Innovation

GOAL
& VALUE

Identify, develop, qualify engineering and construction technologies that enable:

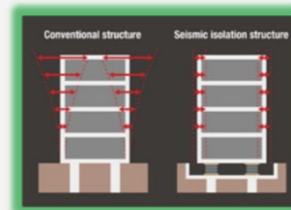
Reduced Cost | Increased Quality | Improved Efficiency



- Modular Construction Technologies
- Structural Health Monitoring
- Digital Twin Applications

Construction Technologies

- Risk-Informed Performance-based Design Solutions
- Steel-plate Composite (SC) Structures Analysis Guide
- Analysis of Systems and Components



Engineering Solutions



- Assessing Concrete Behavior under Elevated Temperatures
- Testing high-strength Large Steel Rebars for applications
- Self-consolidating Concrete for Mass Construction Applications

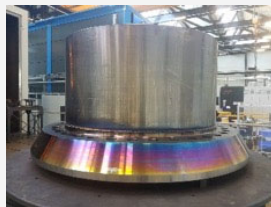
Concrete and High Strength Rebars

Advanced Manufacturing and Materials

GOAL
& VALUE

Identify, develop, qualify, & implement more economical manufacturing, inspection & new materials that enable:

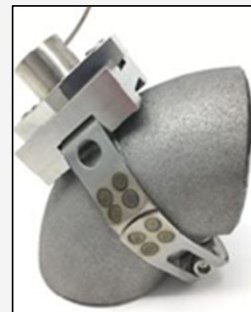
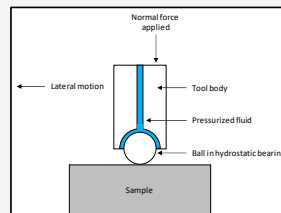
Higher Quality Components | Reduced Lead Times | Alternative Supply Chains | Cost Competitiveness | Enable Deployment



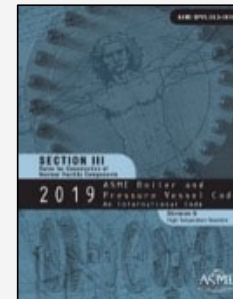
- Evaluate, Qualify, and Demonstrate Advanced Manufacturing Methods
- Additive Manufacturing
- PM-HIP
- Advanced Welding
- Mechanical Connections
- Advanced Cladding

Advanced Manufacturing

- Mitigation Techniques
- Chemistry Control
- Risk-Informed Strategies
- Advanced Sensors
- Enhanced Specifications



Material Performance
and Inspection



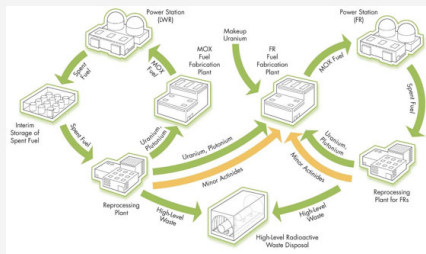
- AR Materials Development
- Materials Qualification
- Degradation Mechanism (MMM/MDM)

New Materials
Development

Nuclear Design and Fuel Cycle

GOAL
& VALUE

To support the diverse mission and fuel cycle needs of the future advanced reactor fleet by:
Accelerating fuel cycle readiness | Enabling advanced fuel design | Supporting innovative reactor development



Evaluating:

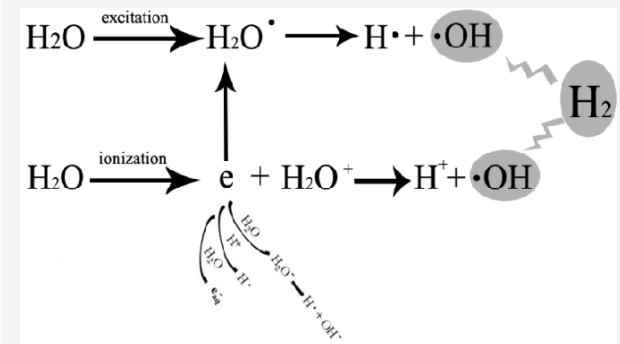
- **Near-term** impacts for licensing, commissioning, and initial operations
- **Mid-term** impacts for steady-state commercial operation
- **Long-term** impacts from recycling and disposal options

AR Fuel Cycle
Back-end Analysis

- Evaluate application for existing designs to apply to other needs
- Preserve disposal flexibility while serving multiple storage roles



Evaluation of Current
Used-Fuel Storage for ARs



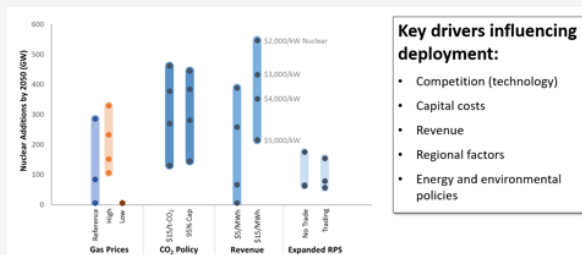
- Identify potential processes that could directly produce hydrogen safely within a reactor core
- Evaluate commercial potential of each such process

Direct Production of Hydrogen

Project Development and Execution

GOAL
& VALUE

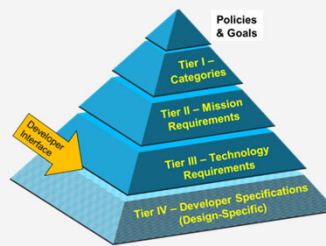
To reduce the schedule, cost and risk of new advanced reactor projects through the following:
Tools for Project Development | Optimized Project Execution Strategies | Integrated Digital Project Execution



- Market Analysis
- Integrated Resource Planning
- Techno-Economic Assessments
- Non-Electric Mission Assessments
- Project Lifecycle Optimization
- New Plant Technical Assistance

Strategic Analysis & Planning

- Siting Guide
- Owner Operator Requirements Guide
- Technology Assessment Guide
- Plant Conceptual Design Evaluations



Project Development



- Project Execution Guides (incl Project Management, Engineering, Procurement, Construction, Commissioning)
- Model Based Systems Engineering
- Digital Engineering

Project Execution

Initial Operations and Maintenance

GOAL & VALUE To ensure a smooth transition to initial operations, and through the first fuel cycle by:
Enabling effective plant turnover | Supporting operational efficiency | Documenting lessons learned

- Passive safety systems
- Series startup
- Critical path optimization



Recent Startups Experience

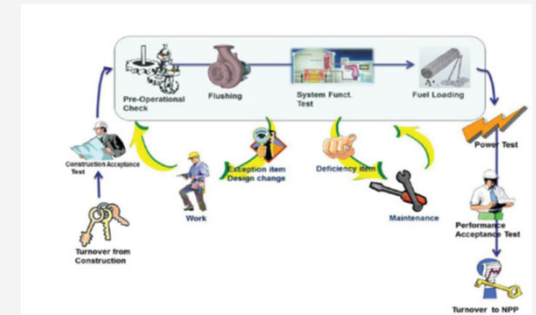


- Near-term **opportunities**
- Mid-term **optimization**
- Long-term **automation**

The Autonomous Advanced Reactor

Establishing an Advanced Reactor
Maintenance Program

Update and Expand Plant **Turnover**
Guidance



Source: IAEA Nuclear Energy Series No. NP-T-2.10

Updating Existing Reports

A blue-tinted photograph of four people, likely EPRI staff, standing in a row. From left to right: a man with curly hair and glasses in a lab coat, a man with glasses in a lab coat, a woman wearing a hard hat and safety glasses in a work shirt, and a man with glasses in a button-down shirt holding a clipboard. The text "Together...Shaping the Future of Energy™" is overlaid in white.

Together...Shaping the Future of Energy™