Advancing Thorium Fueled Molten Salt Reactor R&D in a University Laboratory
Nuclear Energy eXperimental Testing (NEXT) Lab

Finding global solutions to the world’s critical needs
Honduras

• One of the poorest countries in the Western Hemisphere
• Population of over 8 million
• Capital is Tegucigalpa with over 1 million people
Energy Usage Improves Standard of Living

From MIT’s recent study
The Future of Nuclear Energy
Targeted Alpha Therapy

“Extremely effective and highly specific ‘smart bombs’ to target cancer cells”


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Targeted Alpha (α)-particle Therapy (TAT)

- Alpha emitter → Kill the cell
- Chelator → Binding
- Antibody → Target cancer cell
- Antigen
- Cell nucleus
- Cancer cell
Alpha vs Beta Particles in Tissue

4,000 beta particles are required to produce the same effect as one alpha particle.

From Frontiers in Oncology Jan 2014 Volume 3 Article 324
Challenge of Alpha Emitters

• Problem:
  • Must be made.
  • Short half-lives requires a continuous source.

“A major issue that may hamper wide implementation in the clinic and that needs to be simultaneously addressed is the availability of suitable alpha particle emitters”

—From Frontiers in Oncology Jan 2014 Volume 3 Article 324
World’s Critical Needs

Water for Sanitation
1 in 3

Energy to end Poverty
1 in 2

Cure for Cancer
1 in 2

Is there one solution to all 3 needs?
Which Advanced Reactor Design?
Key Requirement 1: Liquid Fuel

- Increased fuel utilization
  - 3-5% vs 100%
- Decreased waste
- Access to medical isotopes
Key Requirement 2: Molten Salt Coolant

- Improved efficiency
- Industrial heat
- Safe
- No phase transition to a vapor
- Walk-away-safe
Key Requirement 3: Thorium Fuel Cycle

- Yields medical isotopes
  - Alpha Emitters
  - Mo-99
- Virtually eliminates transuranic waste
- More abundant fuel source
Nuclear Energy eXperimental Testing (NEXT) Lab

Finding global solutions to the world’s critical needs
provide global solutions to the world's need for:

- energy that is less expensive and safer
- water that is pure and abundant
- medical isotopes used to diagnose and treat cancer

by advancing the technology of molten salt reactors while educating the next generation of leaders in nuclear science.
● We need a commercial Molten Salt Reactor.
● Before NRC will license that, a test reactor must be built.
● To support that, NEXT lab will build a non-nuclear molten salt test system capable of:
  ○ testing advanced instrumentation,
  ○ evaluating different salt properties,
  ○ making fundamental data measurements, and
  ○ testing molten salt hardware.
Bridging the “Valleys of Death”

Effort & Competence

Discovery

Applied Science

Serial Production

NEXT

R & D Test Beds

NATIONAL LABS

Demonstration and Deployment Test Beds

Emphasis on early discovery; focus on solutions with smaller technical complexity

suited for high-complexity, multi-disciplinary, horizon challenges that span the fundamental to applied R&D

Market needs & competitive pressure focus R&D on near-term solution
Three phases

• PHASE ONE
  • Initiate an on-campus research program to demonstrate our understanding and abilities to safely prepare, heat, flow and study salt mixtures.
  • Completed 2017

• PHASE TWO
  • Build a basic molten salt test loops for advanced testing.
  • 2018-2020
  • Fully Funded ($4 M)

• PHASE THREE
  • Build a full-sized, non-nuclear molten salt loop.
  • 2021 –
  • Looking for collaborators
NEXT Team

- ACU
  - 10 Faculty and Staff members
  - 17 students currently involved
  - 5 lab rooms
  - Advisory Board
- Building larger collaborations
  - Collaborating on VTR at INL
  - Collaboration discussions others
Interdisciplinary Research Project

Engineering: 3D CAD models completed for MSTL.
Computational Fluid Dynamics studies are ongoing.
Instrumentation Development
Salt Measurements and preparations in progress.
MSTL Initial Flow and Sample
Summary

• There is a great need for advanced molten salt reactor development.

• There is a lot of common ground in this community.

• NEXT Lab at ACU utilizes a large interdisciplinary team to improve the technical readiness level of molten salt reactors.

• Significant progress has been made. More to come...
Thank You

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