

DES Presentation

2024-10-08

***Technologically Advanced and
Rapidly Deployable Integrated
Power and Water Systems that
Minimize Logistics Tails***

Robert L. Campbell
Founding Executive Chairman
CAP Water & Power International, Inc.





Problem Statement

- ***“The U.S. Marine Corps faces several water-related challenges both at home, at bases around the world, and for expeditionary forces. These challenges include water scarcity, logistical difficulties in transporting water, and the need for clean, reliable water sources in remote or hostile environments.”***

Marine Corps Installations Command: Installation Campaign Plan for Environmental Resilience and Energy Readiness (Oct 2023)

Introduction

- **Presenter**
- **Corporate**
- **Background and Motivation**
- **Objectives of Presentation**
- **Invitation to Actions**

BLUF

Goal is to strengthen national security through rapid development and deployment of Technologically Advanced and Lower Cost Integrated Power and Water Systems that minimize Logistics Tails

Presenter

- Robert Leo Campbell
 - A short Biography and CV will be on DES Website
 - Founding Executive Chairman of CAP Water & Power International, Inc. (CAPWAPII)
- Industrial Experience
 - 25 years in Defense Industry
 - 22 years in Water & Power Infrastructure Industry
- National Service
 - Active Duty, Army
 - National Academy of Science, Naval Studies Board

CAP Water & Power International (CAPWAPII)

- A 22-year-old Private Corporation that has developed advanced technology and systems for the installation, commissioning and operation of commercial modular seawater desalination systems powered by renewable energy
- International operations in North Africa, Middle East, and Latin America
- Coordinating with Regional Affiliates, builds owns and operates water and power plants under 25 year off-take contracts
- Relocating R&D, Product Engineering, International Regional Joint Venture Management and select other functions to Monterey, CA



Background and Motivation for this Presentation

- CAP has successfully brought the NexGenDesal system from Concept (TRL1) to Commercialization (TRL9)
- Much of the technical success is the result of Cooperative Research and Development Agreements (CRADAs)
- CAP is now working to validate its next System, the Ejector Vapor Compression Distillation System (TRL7) to be integrated with Small **Modular** Nuclear Reactors
- CAP is developing new renewable energy sources and storage methods
- We are seeking to engage/sponsor NPS faculty and students with similar interests and related science and technical expertise

Objectives of Presentation

- Inform prospective parties who may be interested in CAP's Systems, Technologies, Scientific Research, and International Affiliations
- Support the development of a CRADA between NPS and CAPWAPII to focus on topics of mutual interest and shared expertise.

THE OCEAN FIXES EVERYTHING

Water, Kinetic Energy,
 H_2 , O_2 , CO_2
 U_{235} , REE



Big Picture: Water & Power Interdependency

Water and Power are inextricably linked

The Nexus of Water and Power is Multifaceted and Complex

The Physics of water remains a mystery; "water is the most anomalous substance"

The mechanisms of solar radiation on surface water remain unexplained.

Investment in development of new power technology is viewed as lower risk than that for water,

Many consign water science in the same bin as cold fusion.





CAP Water & Power International

Goal is to strengthen national security through rapid development and deployment of Technologically Advanced and Lower Cost Integrated Power and Water Systems that minimize Logistics Tails

SYSTEMS ENGINEERING PHILOSOPHY

- Agile Design Process (e.g. TCR at ORNL)
- Parallel Element Modular Systems
- Factory Manufacture, Integration, and Test Modules
- Eliminate EPC
- High MTBF, Low MTTR, Predictive Maintenance/Logistics
- Employ COTS, partner with research Labs and Universities
- Achieve Economies of Scale through Advanced Manufacturing

Ideal Solution for Expeditionary Water Requirements

Transportable configurations of NexGenDesal with Hydrogen Microgrid

Potable water from seawater with:

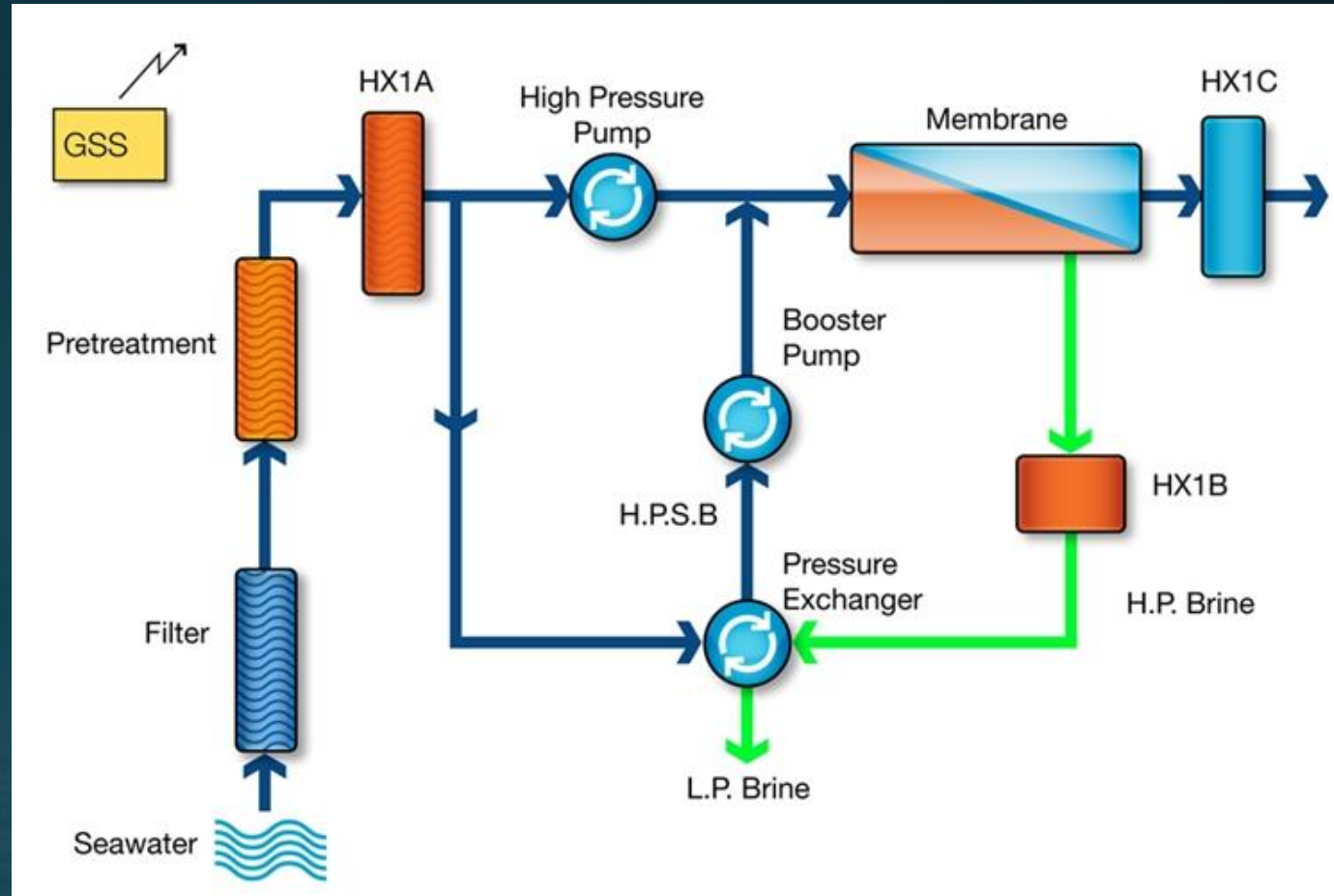
- No logistics tail for fuel or consumable chemicals
- Low physical, acoustic, and IR signature
- EMP resistant
- Autonomous operation
- Predictive diagnostics
- Sensors for new and predicted waterborne agents

The NexGen Desal System

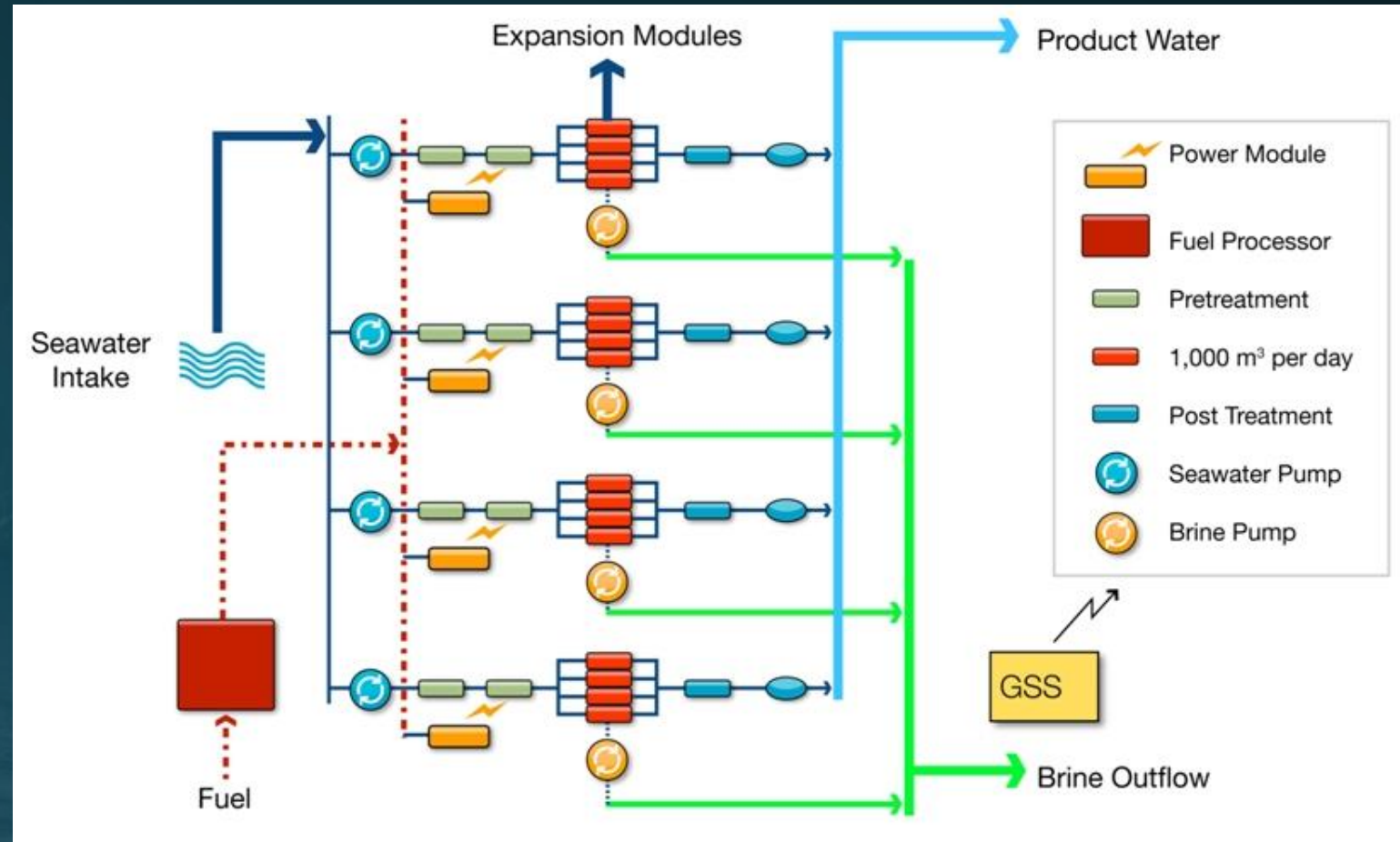
[The NexGen Desalination System Technical Overview by CAP Holdings \(youtube.com\)](#)

- Lowest Specific Power Consumption
 - Lowest Carbon Footprint in the Industry
 - Powered with Renewable Energy
 - No Consumable Chemicals
 - No On-Site Operators
 - Environmentally Friendly
 - Lowest Projected Total Cost of Ownership

Introduction to NexGen Desal System

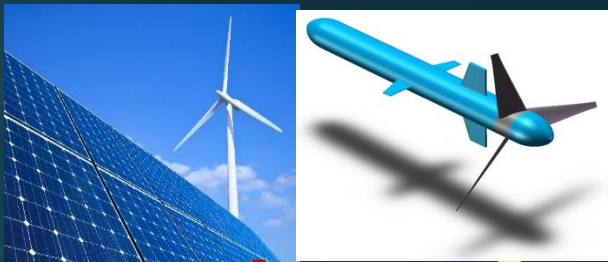


Introduction to NexGen Desal System



Tightly Integrated Power and Water

Renewable Energy Sources



Seawater

DC Power

Global Secure SCADA

Desalination Plant



Permeate

DC Power

H₂O



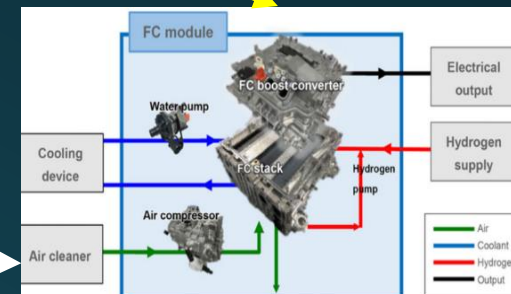
High Pressure Electrolyzer



High Pressure Gas Storage

O₂

H₂



Hydrogen Fuel Cell Subsystem

Brine

DC Power

H₂O

Demonstration System at CAP R&D

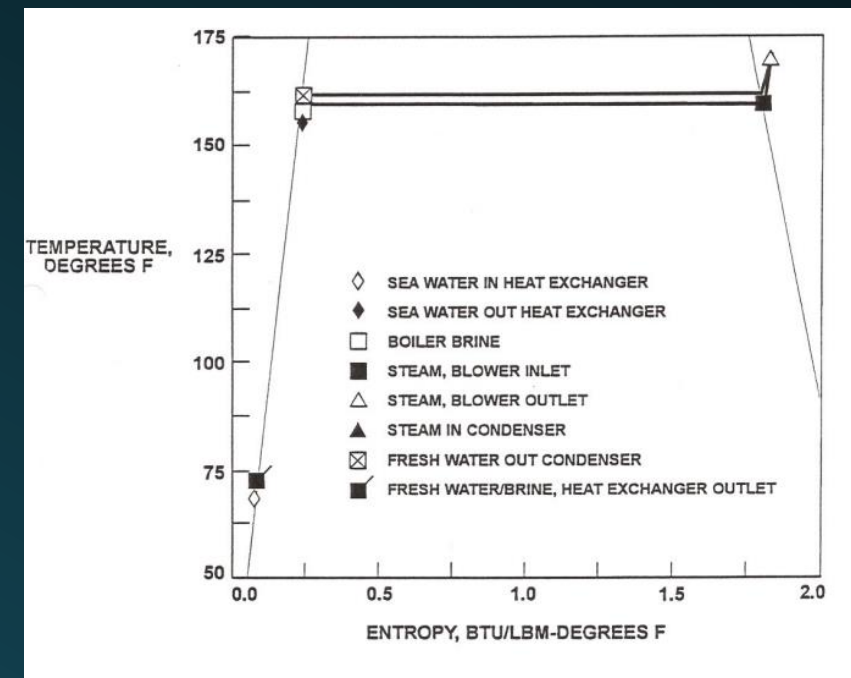
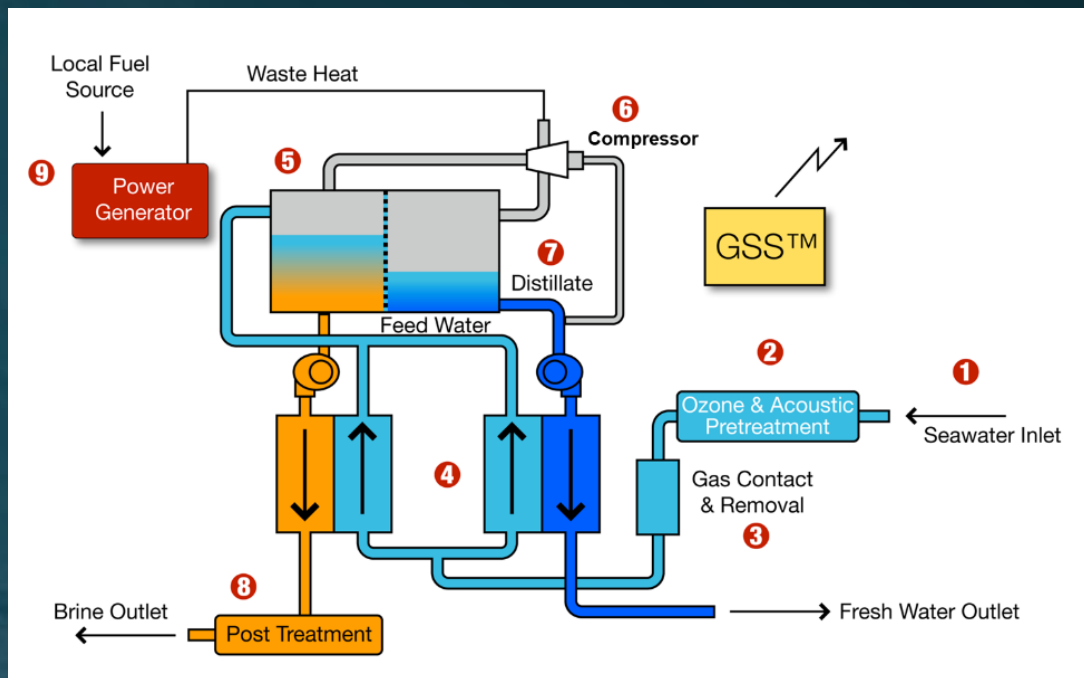


[The NexGen Desalination System Technical Overview by CAP Holdings \(youtube.com\)](#)

SMD: Small Modular Desalination System

Ejector Vapor Compression Distillation (EVC)

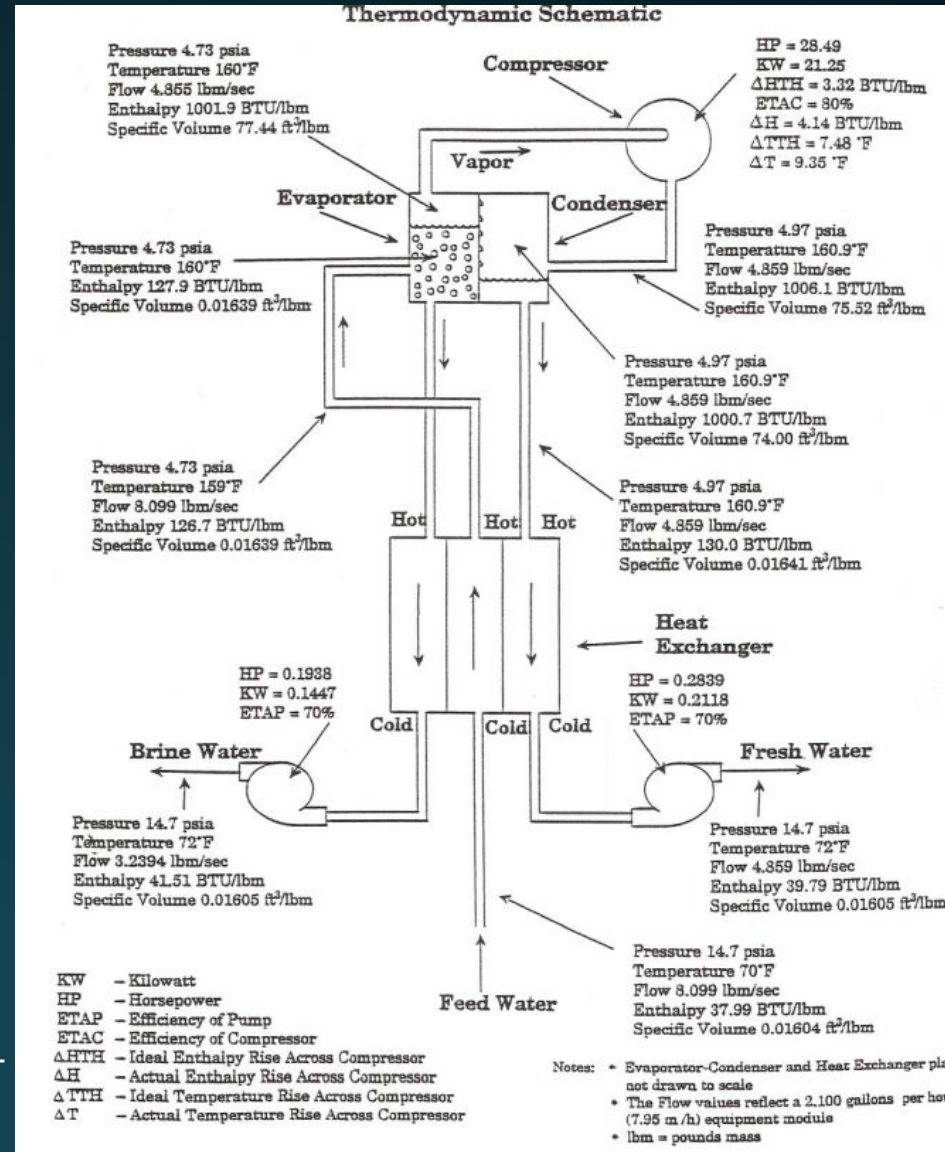
Employs both thermal and electric output of TCR



1 k m³/day modules
 Parallel for up to 5MGD per site
 Estimated 15 5MGD units per SMR

Nearly perfect Adiabatic/Isotropic
 Thermal Cycle

Prototype MVC tested in Malta



Fan Compressor (ABB)
Plastic E/C (Hadwaco)
Six years of operation & Test

Advanced Technologies for EVC

Hypercritical Ejector (Compression Stage)

Hydrophic/Hydrophilic Heat Transfer

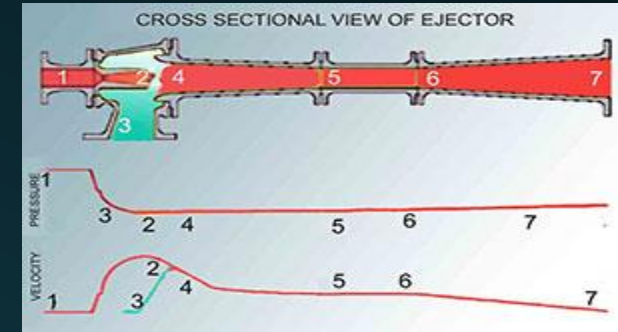
Steam and Fluid Paths within
Evaporator/Condenser Injection Molded Frames

Ideal for Additive Manufacture

FRP Vacuum Chambers

Same Pre & Post Treatment as NexGenDesal

NexGenDesal Global Secure SCADA



High efficiency steam ejector for desalination applications
CAP Patent WO 2002016779 A1
See Appendix A for more details

Ultra Efficient Flat Plate Heat Transfer
CAP Patent <http://patents.justia.com/patent/20020117293>



Nuclear Desalination Initiative

SMD powered by SMR

- SMD is Small Modular Desalinators
- SMR is Small Modular Reactor
- An Advanced Thermal Desalination Process
- Safe, Secure, Sustainable, Affordable, and Exportable
- Team with [InnovX](#) (Uranex, U308)

MODULAR GREEN MASS-MANUFACTURABLE NUCLEAR DESALINATION SYSTEM POWERING EVC

• SMD

- Small Modular Desalinators
- CAP's EVC
- Factory produced Modules
- 3D Printed Components
- Automated Assembly

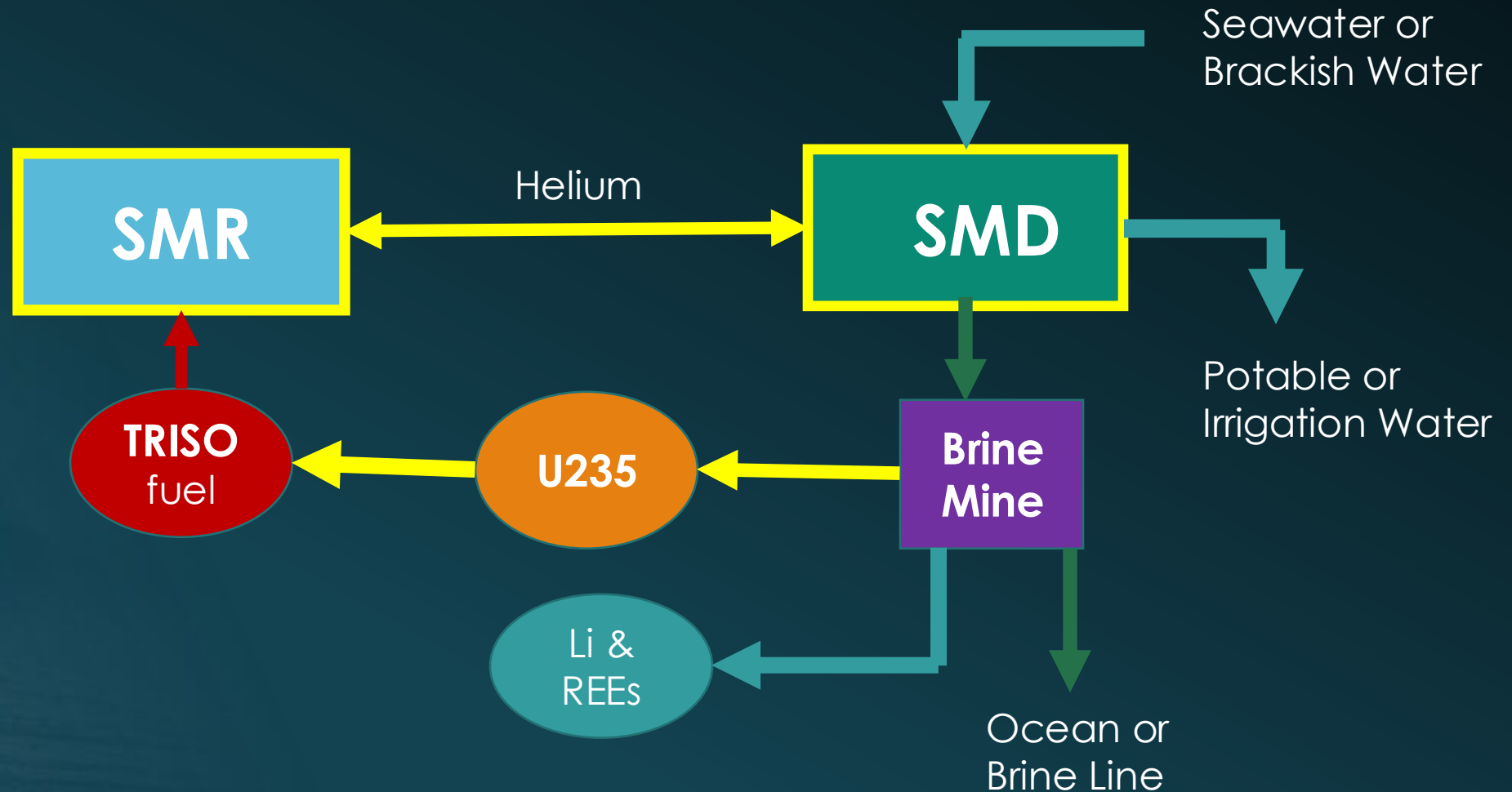


• SMR

- Small Modular Reactor
- TCR from ORNL
- Factory produced Modules and Fuel
- 3D Printed Core and Components



Proposed SMD-SMR System



Features and Benefits of TCR

Transformational Challenge Reactor

Small Modular Design

Low Cost

Rapid Deployment (minimum ECP/Regulatory Approval)

Gas Cooled (He) (no radioactive transport to SMD)

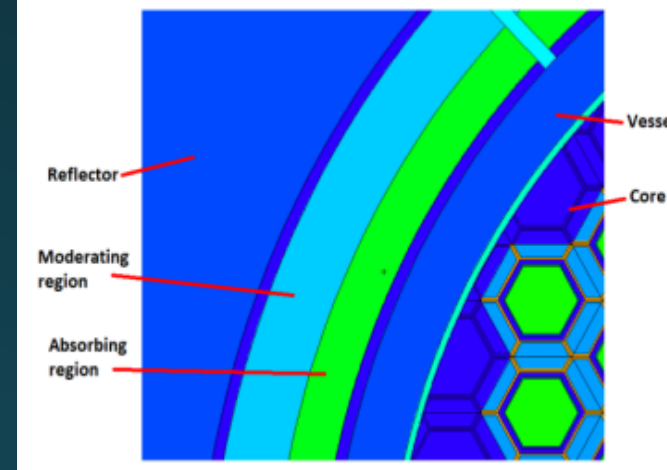
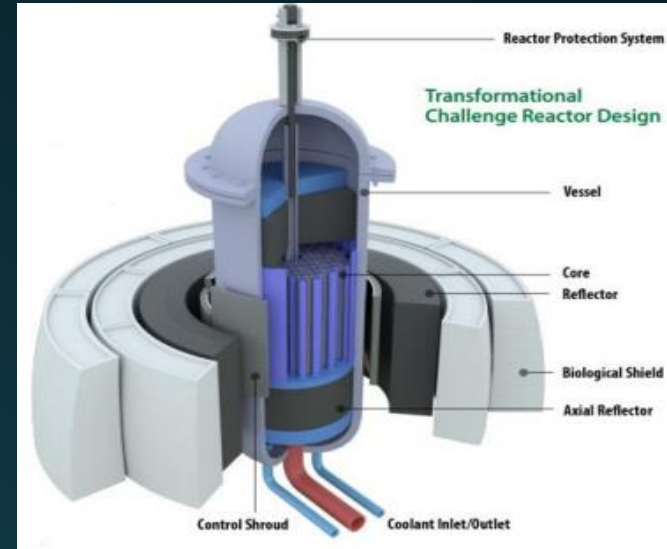
Additive Manufacturing

AI Manufactured and Operated

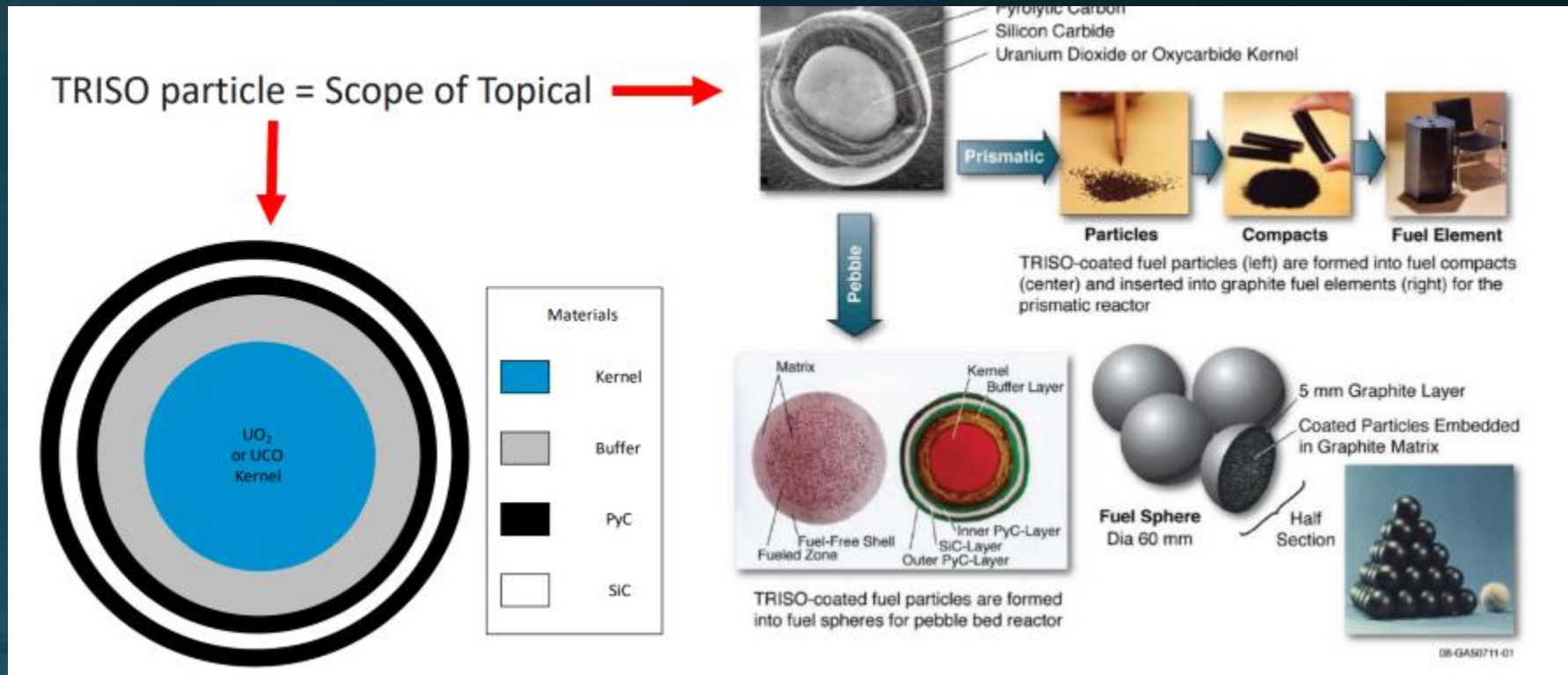
Reactive Control

New Moderator Material (YH₂)

Embedded COTS Sensors



TRISO: Uranium Oxycarbide Tristructural Isotropic Coated Particle Fuel



Mass produced by [Ultra Safe Nuclear, Inc.](#) at ORNL
[Orano](#) at ORNL for concentration, [InnovX](#) Uranex

Extraction of U235 from EVC Brine

- Uranium reserves found naturally are on a course to reach exhaustion
- Seawater contains 4.5 billion metric tons of uranium
- Indian researchers captured over 95% uranium within two hours

Most efficient methods to date are from India, Japan, and ORNL.



The EVC can be operated to produce very highly concentrated Brines thereby enabling higher capture rates.

CAP Enabling Technologies

Combined Effects Pretreatment

Fully Automated Plant Operations

Predictive Diagnostics

Global Secure SCADA

High Pressure Electrolyzer

Additive Manufacturing

New Initiatives at CAPWAPII for 2025

LiFi SCADA testing facility: replace cabled and WiFi SCADA

Quantum Sensor Lab: QPS and Ocean Floor Mapping

Launch Electric Whale Prototype at sea testing

Symposium Series on Water Physics: Fourth Phase and H2 Bond

Establish Nuclear Power Department

Establish Module Integration and Test Facility in Bend Oregon

Invitation to Action

Immediate Actions

Questions and Answers

Arrange follow on meetings

Propose CRADA projects

Next Actions

Develop NPA/CAPWAPIi CRADA

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