



Idaho State
University

Classical vs. Modern:

The Tale of Two Reactors at

Idaho State University

TRTR 2026

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ROAR

Your Hometown Nuclear University

Idaho State University

- Main campus in Pocatello, ID, satellite campuses in Idaho Falls, Twin Falls, and Meridian
- State-designated school for health sciences and nuclear energy
- Only Idaho university to offer full range of degrees in nuclear engineering (B.S., M.S., Ph.D) & nuclear operations (A.S.)
- Operates NRC-licensed AGN-201 for training and research



Part I: The AGN-201



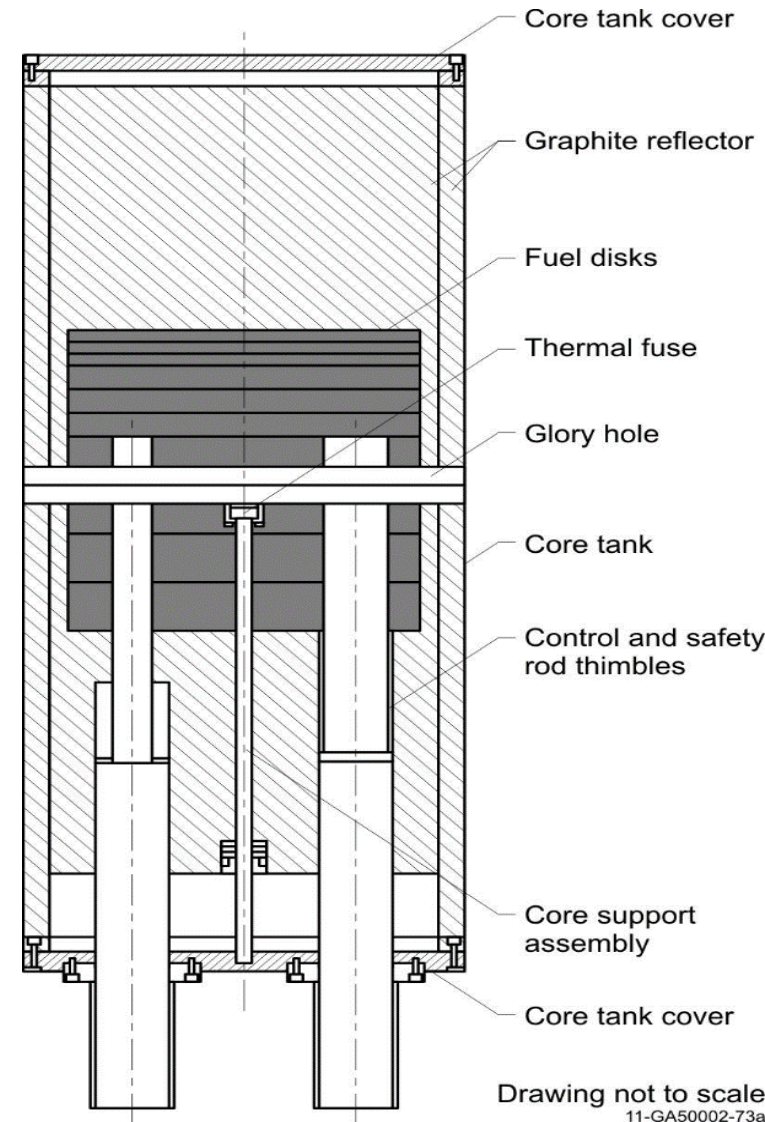
AGN-201 Nuclear Reactor

~4000 US Universities

- ~40 Offer a Nuclear Engineering Program
 - 24 have a nuclear reactor

ISU, UNM, and Texas A&M have an AGN-201

- In operation for more than 60 years
- Capable of supporting research
- Primarily used for teaching & operator training

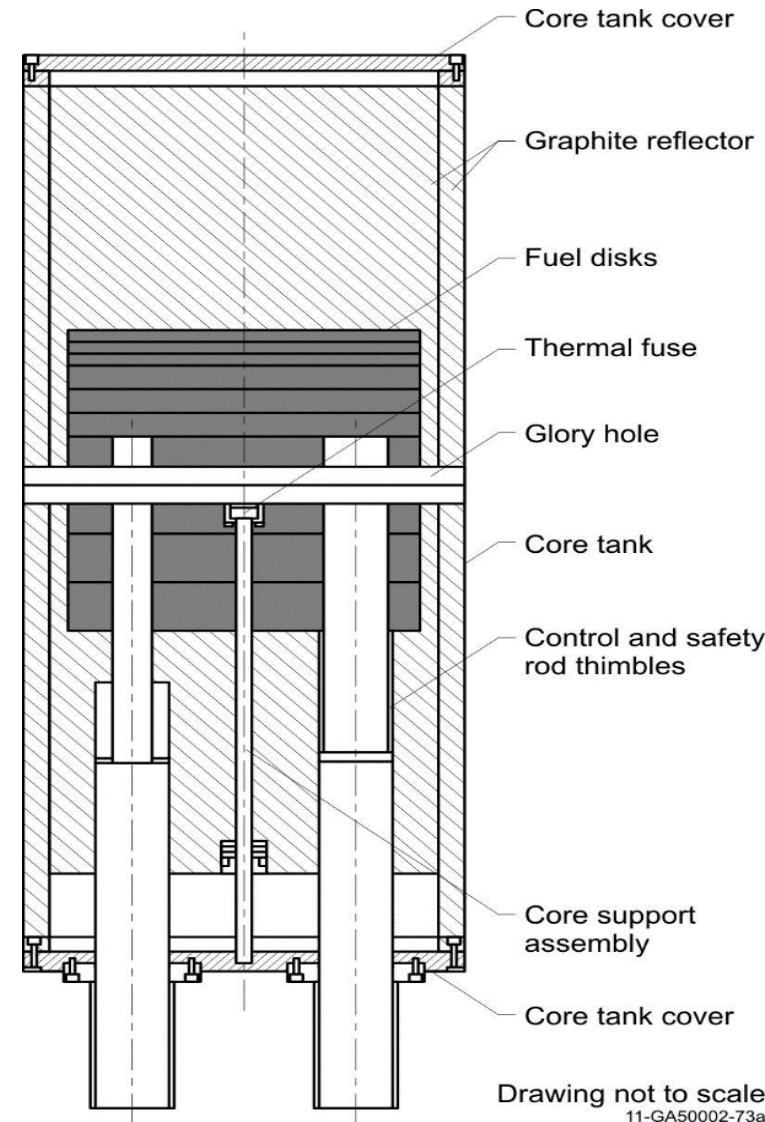


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AGN-201 Nuclear Reactor

- Low operating power $< 5W$
- No active cooling
- Fueled controls rods
- Direct access to core center
- Four irradiation ports



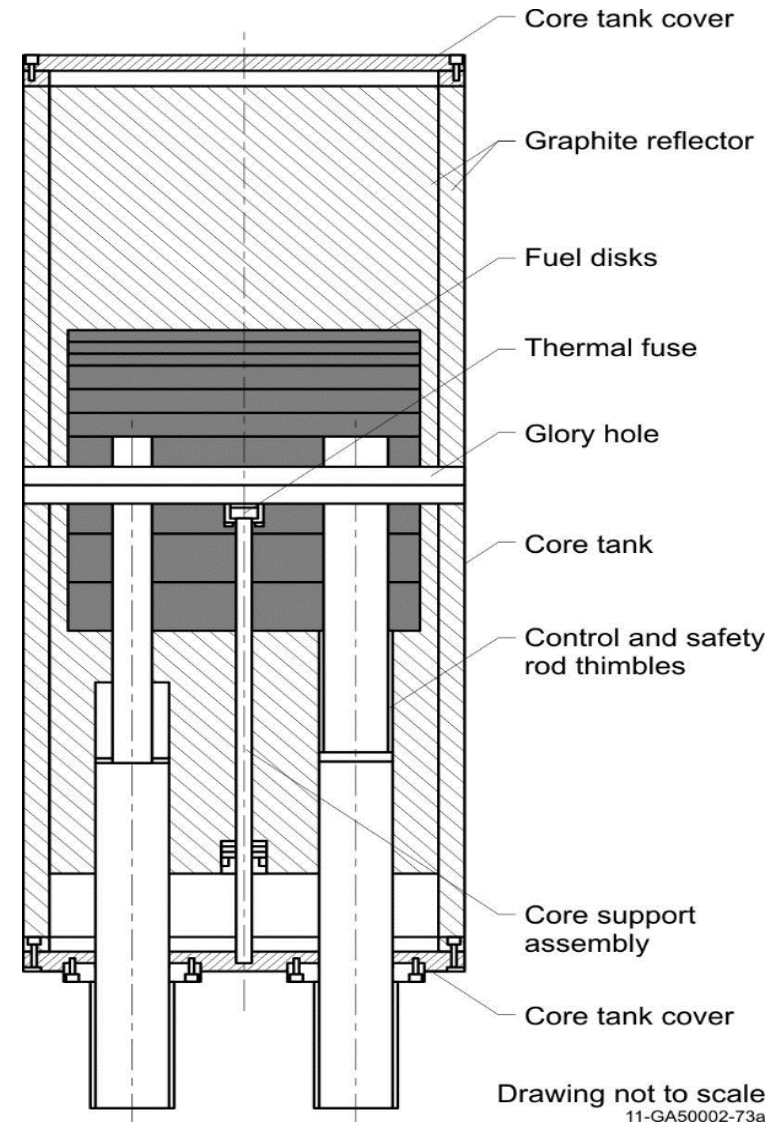
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AGN-201 Nuclear Reactor

- 19.75% enriched uranium
- UO_2 [20 micron diameter particles]
- Mixed with polyethylene (C_2H_4)
- Overall density: 61 mg $^{235}\text{U}/\text{cm}^3$
- Total uranium density: 305 mg/cm^3
- 1 g U : 3.16 g polyethylene



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AGN-201 Nuclear Reactor

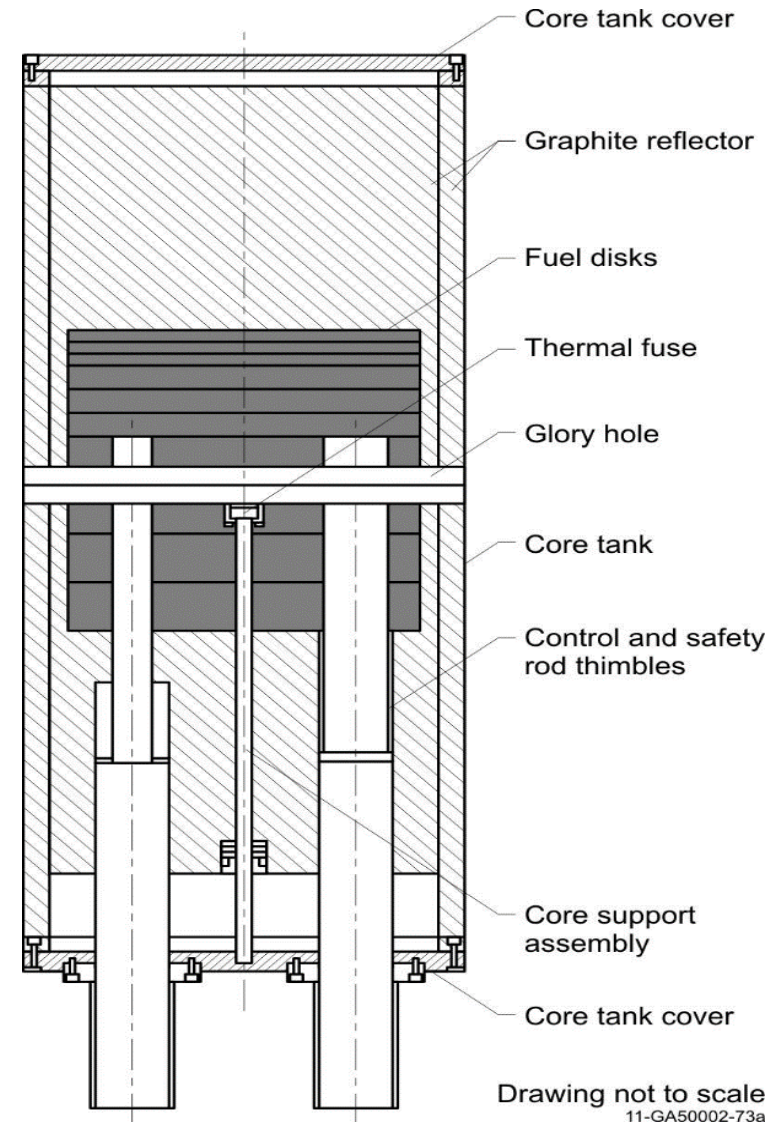
Nine fuel disks (25.6-cm diameter)

- Four disks 4-cm thick (96 g ^{235}U ea)
- Three disks 2-cm thick (58 g ^{235}U ea)
- Two disks 1-cm thick (29 g ^{235}U)

Four Control Rods Total

- Two Safety Rods
- One Coarse Control Rod
- One Fine Control Rod

*** Control rods are fueled rather than poisoned ***



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AGN-201 Nuclear Reactor

Graphite Reflector

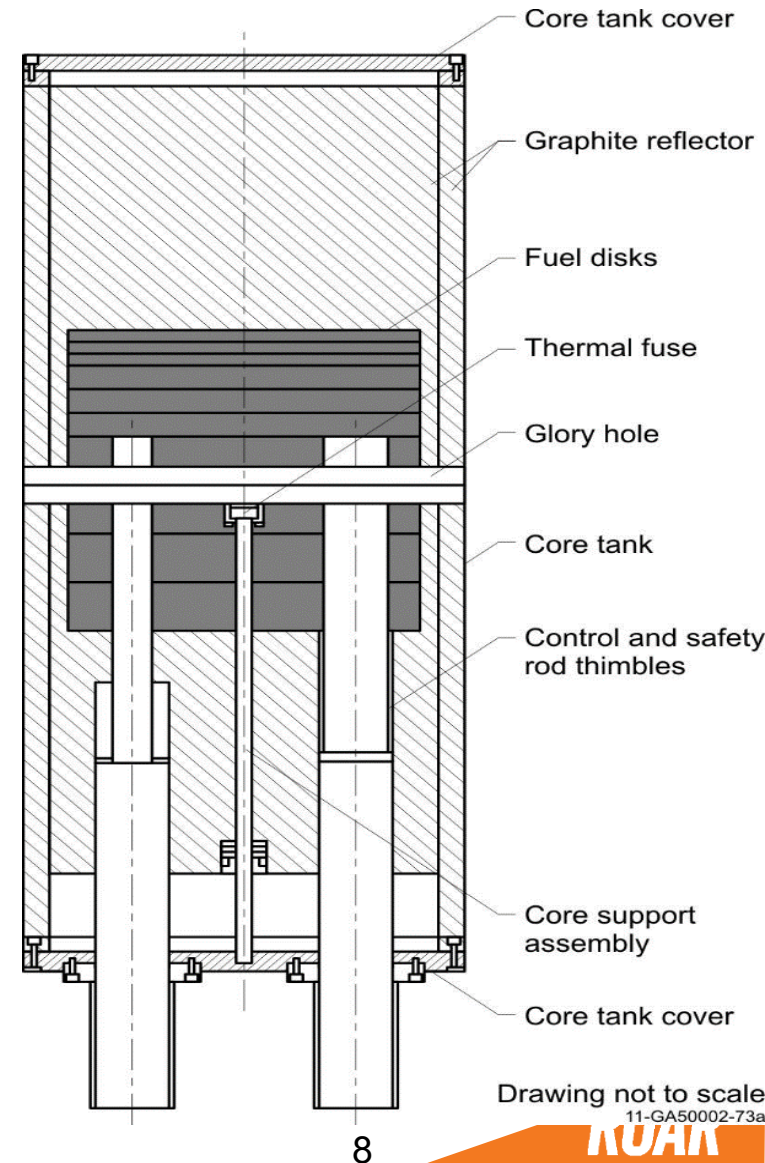
- 1.75 g/cm^3
- 20-cm thick (radial and axial)

Lead Gamma Shield

- 10-cm thick (radial and axial)

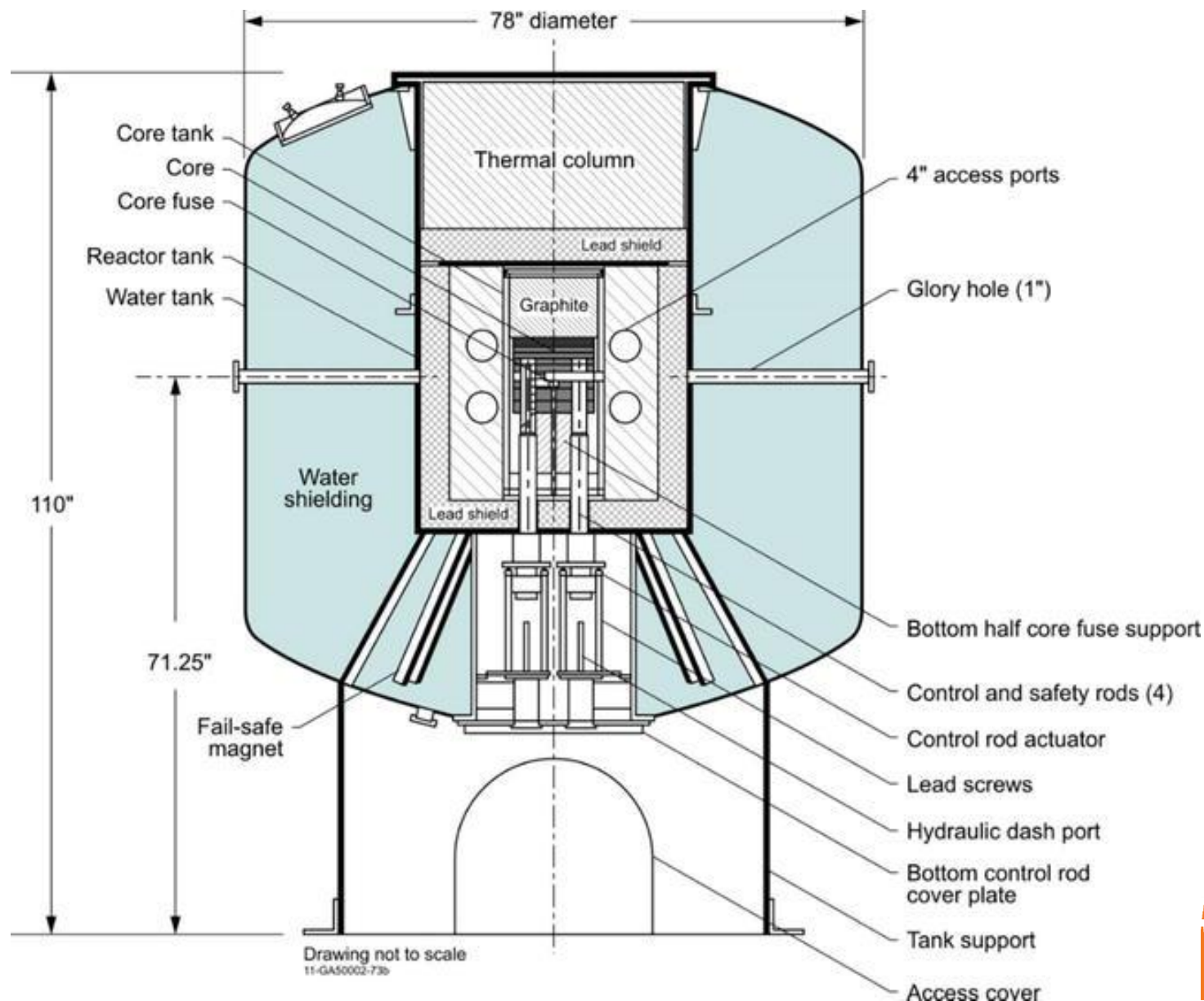
Water Neutron Shield

- 55 cm thick





AGN-201 Nuclear Reactor





ISU AGN-201 Reactor

- Serves Nuclear Engineering Department and Nuclear Operations Program
- Offers hands-on training, and pathway to become an NRC-licensed Reactor Operator
- Topic of dozens of theses and dissertations
- And still performing active research:
 - Remote operations
 - Digital Twin Development
 - HALEU Benchmarking



Part II: The ISU Advanced Research and Test (ART) Reactor



Advanced Reactors

- What exactly IS an advanced reactor?
- Essentially, any reactor that is not already qualified & licensed by the U.S. NRC to produce commercial power
- In most senses, this means that the reactor uses:
 - Different type or form of fuel
 - Different coolant (i.e. not water)
 - Different geometry or scaling



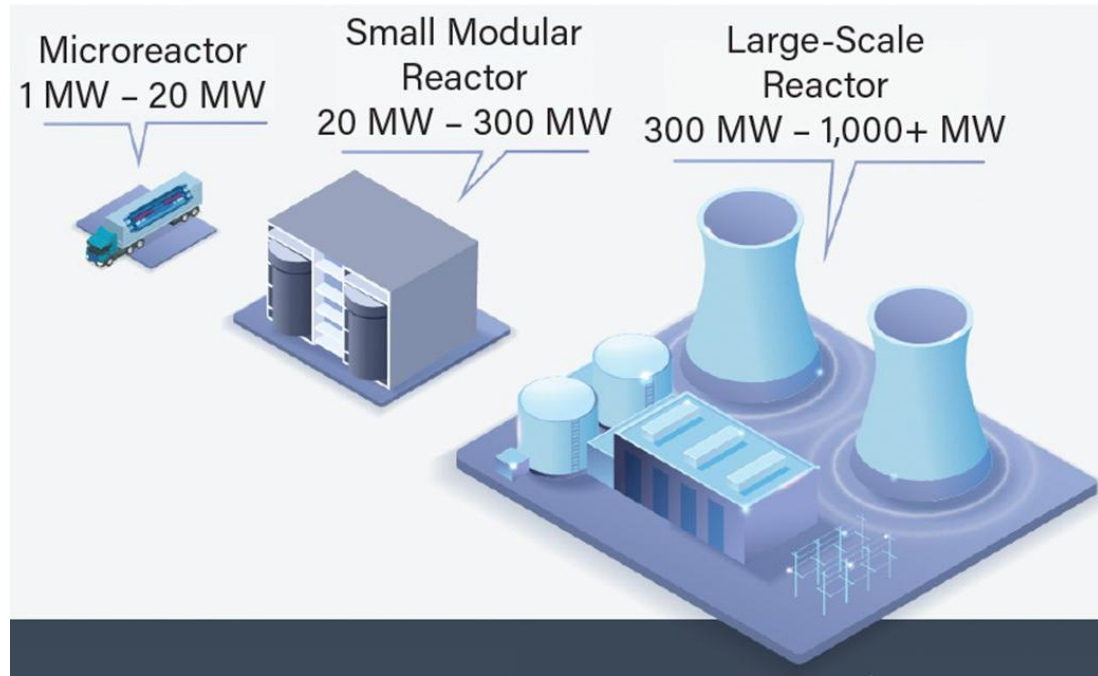
Advanced Reactors

- Reactors are categorized by a series of metrics:
 - Electricity producing vs. non-electricity producing
 - Water Cooled vs. Non-Water Cooled
 - Gen III, Gen III+, Gen IV....
- In reality, the most important category is POWER production (note, NOT electricity):
- Generally provided in terms of thermal power output...



Advanced Reactors

- The three categories for power production are:
 - Large-scale reactor
 - Small modular reactor
 - Microreactor





Something Old, Something New

- The ISU-NuCube Energy partnership will build the Advanced Research & Training (ART) Reactor Facility
- The motivation behind this partnership involves three critical aspects:
 - Provides academic opportunities
 - Enables workforce development
 - Demonstration of novel technologies coupled to an advanced reactor
- As the state of Idaho becomes a leader in the nuclear industry, facilities like ISU ART will play a vital role!



Why ISU?!?

- ISU already has a “microreactor” on campus. Why do we need another one?!?
- ~~More is ALWAYS better....~~
- OK, it’s not that simple, but consider this:
 - The AGN-201 reactor is licensed by the NRC
 - Our students can train to become operators, licensed by the NRC
 - The fuel in the AGN-201 is HALEU (19.75% enriched), which is currently the form of enriched U available to startup companies for fuel...

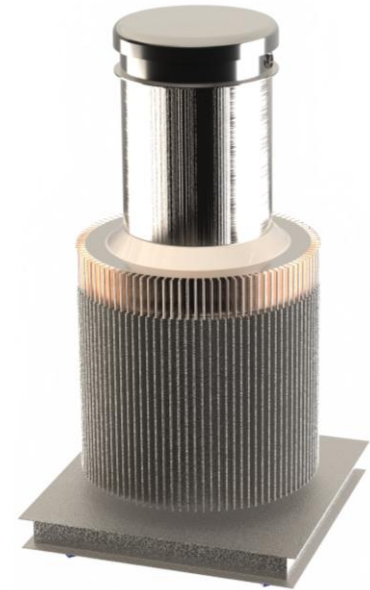
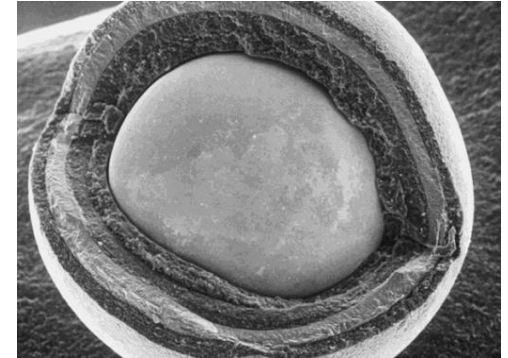


Why NuCube?!?

- NuCube formed in 2023, from the remnants of a different start-up company
- Most of the key leaders are former INL or former industry professional...all with significant ties to Idaho!
- Several of the NuCube staff have worked with ISU NE faculty members...
- The conversation about the ART reactor began as most do...at a party!

The NuSun Reactor

- The NuSun Reactor:
 - TRISO Fueled
 - Heat-Pipe Cooled
 - Capable of 1100 °C output
 - Graphite Moderated
 - Can accommodate HALEU or LEU+
 - ISU unit will produce $\sim 4 \text{ MW}_{\text{th}}$
- Is not scheduled to produce electricity for ISU

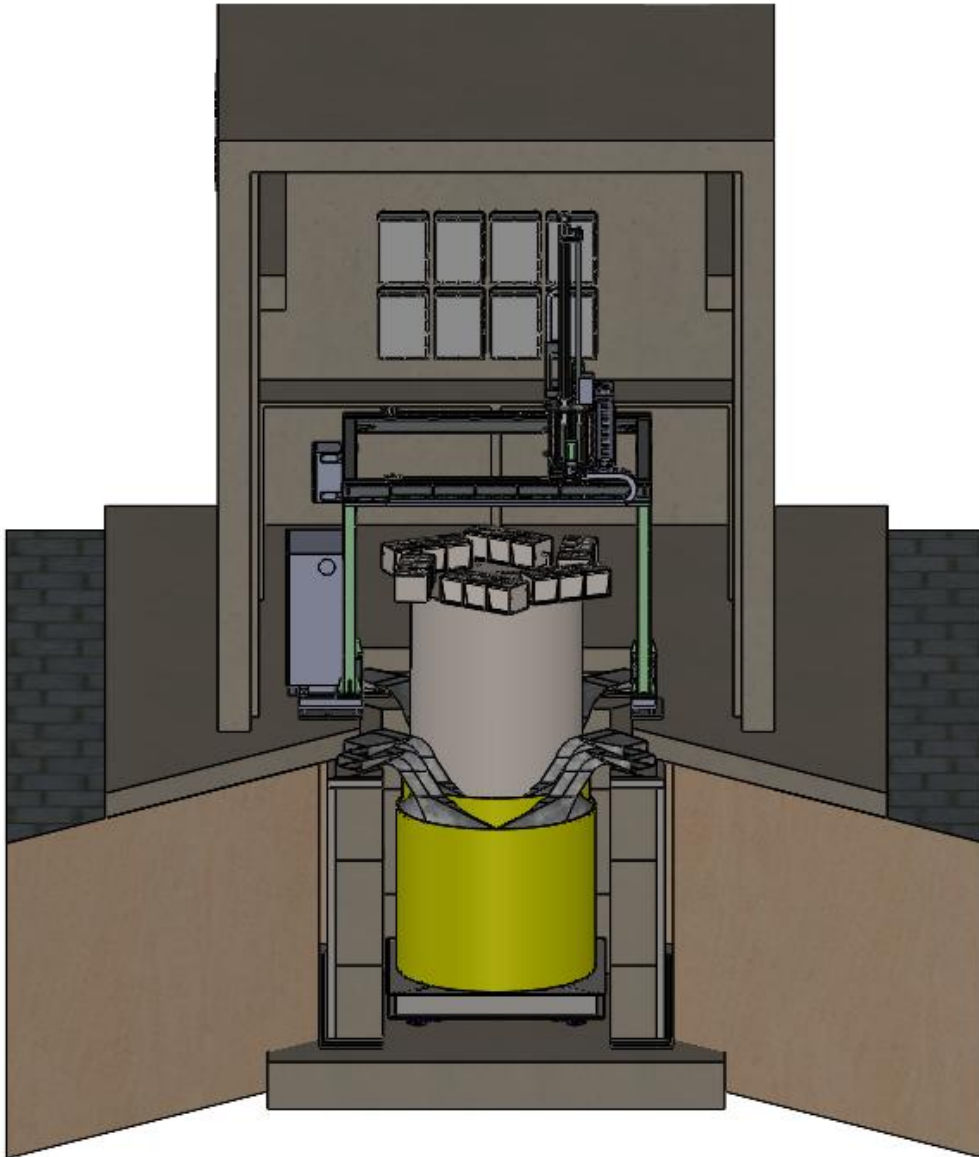


The NuSun Reactor

- The NuSun Reactor is a good choice for use as a research reactor
 - Solid fuel, solid moderator, solid heat removal
 - Designed to minimize the number of moving parts
 - No core cooling pumps
 - No pressurizers
 - No ASME code pressure vessel
 - Designed for full passive safety
- Primary goal: produce industrial heat

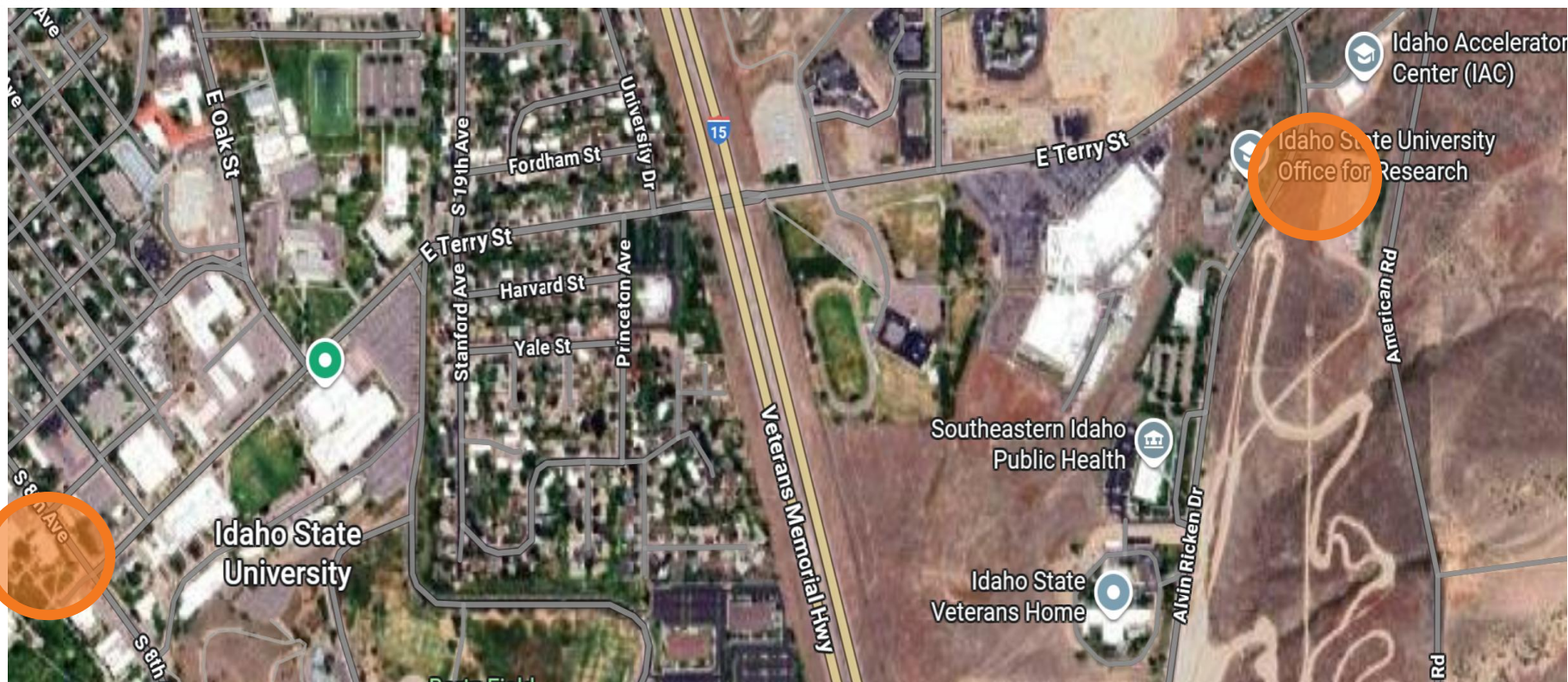


Reactor Building



- 10,000 ft² (approx.) facility
- Houses reactor and supporting systems
- Local controls in place, but primary control room will be located off-site
- Designed to study remote and autonomous operations

Proposed Placement of ISU ART Facility



- Facility placement away from main campus on ISU-owned property (east of I-15)

All Hands On Deck...

- What will it take to build a new reactor on campus?

