ARC-100

A Sustainable, Cost-Effective Energy Solution for the 21st Century

ARC

ADVANCED REACTOR CONCEPTS, LLC

A New Model for Nuclear Power

With worldwide demand for electrical power expected to double over the next 25 years, the world faces a daunting new challenge: provide affordable electricity to an expanding population with a rapidly increasing per-capita energy consumption rate without exacerbating climate change or fostering nuclear proliferation. Advanced Reactor Concepts, LLC (ARC) will address and resolve this challenge. ARC is developing a distinctive new technology for green power generation: an exportable, factory-produced, small-scale (50 MWe – 100 MWe) nuclear reactor with fixed fuel costs for 20+ years.

The ARC-100 Reactor

Due to its proposed long-life and proliferation-resistant fuel cycle, the ARC-100 reactor represents a significant enhancement in proven fast-reactor design that will open new markets to nuclear energy. It offers a new model for nuclear power that is based on the factory fabrication of modular components that can be shipped for rapid site assembly thereby promoting the prompt start of a revenue stream.

Key features:

- Small Size
- Highly Secure Deployment – Below Ground
- Passive Safety Features – Proven Safety Record Through EBR-II
- Advanced Monitoring & Control
- Infrequent Fuel Handling & Shipment

The ARC-100 reactor system is a 100 MWe liquid-metal (sodium) cooled "fast-neutron-spectrum" reactor using a proven metal alloy fuel design. The reactor system is comprised of a small uranium-fueled nuclear core, submerged in a tank of ambient pressure liquid sodium. The liquid sodium is passed through the core where it is heated to 950°F (510°C). It is then passed through a heat exchanger where it heats sodium in an intermediate loop, which in turn heats working fluid for energy conversion turbines. Energy conversion can be through conventional methods or through the implementation of the more efficient Brayton Cycle. (A schematic drawing of the ARC-100 reactor system is shown in Figure 1, opposite.)

Key applications:

- Distributed Power
- Incremental Capacity Additions
- Base Load & Load Following
- Water Desalination
- Shale Oil Extraction

Cost Effectiveness of the ARC-100

The ARC-100 reactor system is very economically competitive. It is designed to produce electricity at a target cost of approximately $0.05 per kilowatt-hour. Long-life fuel packages freeze the ARC-100 reactor's fuel costs for 20 years or longer and thus facilitate energy security for its clients. Additionally, the ARC-100 reactor offers the capability to follow varying load requirements brought on by changes in levels of demand. The performance of its metal alloy fuel is exceedingly well demonstrated and can meet the long refueling time interval requirements and load-following demands. New advances in metal fuel design allow shorter cores, simplified fuel-handling equipment, and reduced generation during fuel fabrication.

The modular design of the ARC-100 reactor allows its factory-fabricated components to be shipped and installed at the reactor site using standard, commercially available equipment. This key production concept greatly reduces the 7-10 year onsite construction programs currently required for conventional, large, Light Water Reactors (LWR).

Safe and Secure Fueling Options

The ARC-100 reactor's long-life fuel "cartridge core" requires very infrequent fuel changeovers and can be replaced entirely by factory personnel. Therefore, ARC-100 customers never handle or have direct access to nuclear fuel. The reactor, control rods, and heat-exchange system are physically sealed and located in a silo below-ground, thereby simplifying the containment system and offering excellent protection against unauthorized access. After installation of the reactor vessel, the fuel cassette is inserted, fueling the reactor for 20+ years. The initial fuel load is comprised of uranium, enriched to less than 20%. By converting the abundant isotope of uranium (U238) into fuel *in situ*, the reactor produces as much new fissile fuel as it uses. Therefore, the returned reactor fuel

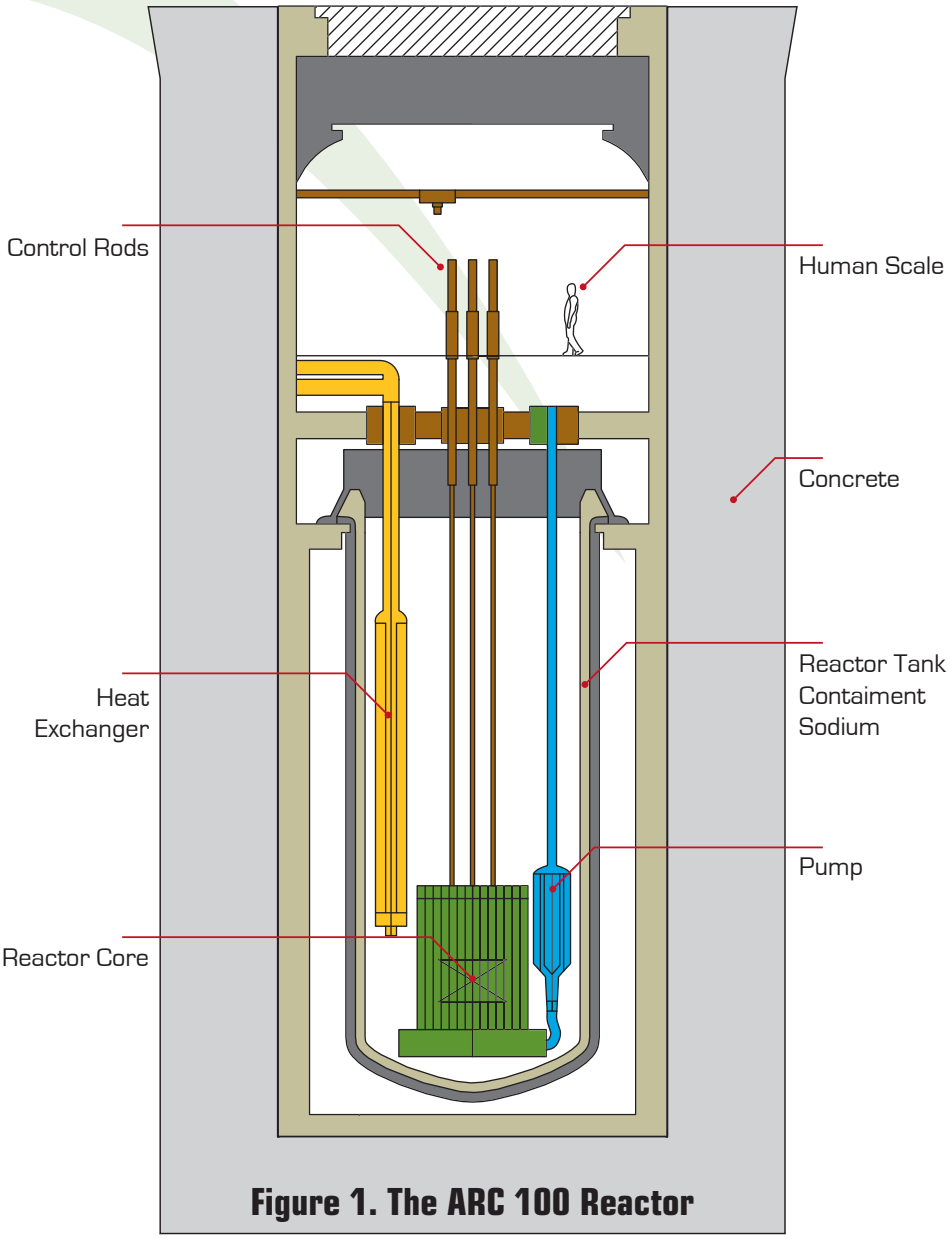

Figure 1. The ARC 100 Reactor

cartridge can be recycled and refurbished for installation into another ARC reactor.

Additionally, the fundamental design and operational characteristics of a fast neutron spectrum reactor offers new solutions to the problem of nuclear waste. Viable fuel sources for the ARC-100 reactor include: a) enriched uranium; b) the waste created by light water reactors (which still contains about 95-97% of its energy potential, unfissioned); c) the large, existing, global stockpile of depleted U238; and d) the nuclear material removed from weapons, which currently creates a serious storage and security problem. Unlike conventional nuclear waste reprocessing technology, creating fuel for the ARC-100 does not involve separating pure plutonium suitable for direct use in nuclear weapons. Instead, it keeps the plutonium mixed with other long-lived radioisotopes so that it cannot be used directly in weapons. The vast majority of waste from an ARC reactor is the much shorter-lived fission products, whose required storage times are measured in hundreds — rather than tens of thousands — of years.

Advanced Reactor Concepts (ARC): Providing Nuclear Solutions for the 21st Century

As the world strives for green energy, the effectiveness of a nuclear component in reaching this goal is increasingly recognized. Up to now, some of the key concerns related to nuclear energy have been based on the technical limitations of conventional solutions with regard to safety, security and waste disposal. The ARC-100 reactor effectively addresses these concerns, while offering an innovative, cost-effective solution for a wide range of global nuclear applications. It also represents an early implementation of Generation IV technology in a solution that should attract a large market. As its flagship product, the ARC-100 reactor positions Advanced Reactor Concepts (ARC) as a leading-edge provider of nuclear solutions for the 21st Century.

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ARC-100 Specifications

Power	260 MWt/100 MWe
Coolant	Sodium (Na)
Pumps	Annular Linear Induction EM (4)
Core Temperature Inlet/Outlet	355°C/510°C
Intermediate Loop	Sodium (Na)
Balance of Plant	S-CO2 Brayton Cycle
Conversion Efficiency	Approximately 40%
Fuel	U/Zr Metallic Alloy
Enrichment (%)	
Inner Zone	10.1
Middle Zone	12.1
Outer Zone	17.2
Fuel Loading	20.7 Tonnes
Refueling Interval	20 Years (Whole Core) @ 0.9 CF
(Discharge TRU+ Remaining U235)/(Initial U235)	0.87
Specific Power	12.5 kWt/kgfuel
Average Power Density	69.5 kWt/litre
Linear Heat Rate	
Average	13.9 kWt/m
Peak	25.5 kWt/m
Fuel Assemblies	
Number	92
Hexagon Flat-to-Flat	17 cm
Pins/Assembly	127
Pin OD	1.298 cm
Overall Height	5.86 m
Fueled Height	1.5 m
Lower Shield	0.6 m
Upper Gas Plenum	2 m
Reactor Vessel	
Height	15.63 m
Inner Diameter	7 m
Thickness	5.08 cm
Material	Austenitic Stainless Steel
Guard Vessel	
Height	15.24 m
Inner Diameter	7.32 m
Thickness	2.54 cm
Material	Austenitic Stainless Steel

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