# Status Report - FLEX Reactor (United Kingdom)

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## 1. Overview

- ☐ **In Operation**
- ☐ **Under Construction**
- ☐ **Described in**

| | |
|---|---|
| Link to PRIS | -- |

- ☑ **New Concept**

| | |
|---|---|
| Number of Units | -- |
| Year | -- |

**Reference Plant**

| | |
|---|---|
| Name of Site | -- |
| Link to PRIS | -- |
| Net Power Output (MWe) | 24 |
| Gross Power Output (MWe) | -- |

### 1.1 Introduction

The FLEX reactor is a molten salt reactor (MSR). It is graphite-moderated, with a patented two-fluid molten salt core, and is being developed by MoltexFLEX Ltd., a UK-based subsidiary of British company Moltex Energy Ltd. It is designed to contribute towards the CO2 emissions reduction challenge, delivering clean energy at a lower cost than unabated coal or gas at pre COVID-19 prices. The FLEX reactor's design is radically simpler than other nuclear technologies. The FLEX reactor has around 10% of the engineered systems of a conventional nuclear reactor (e.g. PWR). The FLEX reactor is inherently safe, operating at near-atmospheric pressure, which substantially reduces the cost of containment. Its operational safety is provided through inherent and passive safety systems, drastically reducing capital and operating costs.

The FLEX reactor is designed with simplicity in mind. It is small and modular, allowing most components to be factory-produced, facilitating transportability, reducing on-site work, and expediting construction, all of which minimises overall costs and build time. The FLEX reactor maximises use of materials and technology already proven within the nuclear industry, making safety and design substantiation easier and quicker by eliminating the need for extensive research programmes. The FLEX reactor is the thermal neutron (moderated) version of Moltex Energy Limited's globally patented

stable salt reactor technology. That technology is shared with MoltexFLEX's sister company, Moltex Energy Canada Inc., which is developing the fast neutron version of the stable salt reactor.

Stable salt reactors differ fundamentally from all other MSRs in that they restrict the liquid fuel salt to fuel tubes, similar to fuel pins in conventional reactors. A separate, non-active coolant salt transfers heat from the reactor core. This avoids the possibility of pumps, filters, conditioning units and heat exchangers in the primary circuit being contaminated with actinides and fission products, which would put severe demands on those components and make monitoring and maintenance complex and expensive.

The reactor is flexible in its application; it is suitable for grid connection or standalone electricity and heat supply. It enables cost-effective storage of thermal energy for hours to days in MoltexFLEX's chloride salt-based GridReserve® system through its high temperature output. The FLEX reactor primary circuit outlet temperature is 795°C, and GridReserve® provides heat at 700°C. which can be directly used for electricity generation or additional downstream applications in industries requiring high-temperature heat. A typical site may contain any configuration of modular FLEX reactors, each with a thermal power output of 60 MW, equivalent to 24 MWe using conventional steam turbines/generators. During longer periods of low demand, the FLEX reactor can reduce its power output. Its low capital cost makes this economically practical.

FLEX reactors can also be used to directly feed industrial processes, including thermo-chemical hydrogen production, which offers increased efficiency compared to electrolysis. The hydrogen itself can be used in several ways to support domestic, commercial, and industrial applications, such as a direct substitute for gas use in industry, domestic heating fuel, fuel cells for heavy transport, and as a feedstock for synthetic fuels, including ammonia as a bunker-oil substitute for shipping. The reactor is also well suited to combined heat and power generation for district heating.



Figure 1. Schematic of single FLEX reactor unit

## 1.2 Development Milestones

| | |
|---|---|
| 2020 | Initial concept defined |
| 2021 | Initial Safety Assessment Report completed |
| 2023 | Initial concept design matured, progress made towards concept design |
| 2024 | Independent reviews conducted by 3x UK nuclear experts |
| 2025 | TRL3 Fully Achieved |
| 2027 | TRL4 Achieved |
| T*+2years | Concept design achieved (* T = date when significant funding can be raised) |

### 1.3 Design organization or vendor company

### 1.4 Links to designer/vendor website

### 1.5 Design Description

The MoltexFLEX design philosophy is predicated by reducing cost, bringing the technology to market as quickly as possible, and developing a reactor that can be deployed worldwide to meet its mission of having a meaningful impact on global CO2 emissions. MoltexFLEX prioritises simplicity, inherent safety and using materials and manufacturing techniques which already exist at a high TRL. This has led to an extremely simple atmospheric-pressure design which requires no active engineered systems in order to ensure safety. For example, the use of molten salt eliminates the pressure hazard associated with LWRs, placing the fuel in pins eliminates the vast majority of radioactive contamination from the primary circuit and the use of passive decay heat removal removes the requirement for active decay heat removal systems and associated backup electricity generators.

MoltexFLEX's approach is to adopt solutions that are already proven in the nuclear sector, meaning a significant proportion of the design is already mature. The use of proven nuclear materials and well validated modelling tools, mean that in combination, it is possible to rapidly move through the Technology Readiness Levels (TRL). Global deployability is ensured through the use of low-enriched uranium (LEU), and its modular construction.

### 1.6 Licensing Application Support Documents

### 1.7 Reactor Unit in PRIS

## 2. Category Fields

Table 1: ARIS Category Fields

| ARIS Category | Value | Units of Examples |
|---|---|---|

| | | |
|---|---|---|
| Current/Intended Purpose | Prototype/FOAK | e.g. Commercial – Electric/Non-electric, Prototype/FOAK, Demonstration, Experimental |
| Main Intended Application (once commercial) | Baseload, Non-electric (Combined heat and power generation for district heating.) | e.g. Baseload, Dispatchable, Off-grid/Remote, Mobile/Propulsion, Non-electric (specify) |
| Reference Location | Inland, Below-Ground | e.g. On Coast, Inland, Below-Ground, Floating-Fixed, Marine-Mobile, Submerged-Fixed (Other-specify) |
| Reference Site Design (reactor units per site) | | e.g. Single Unit, Dual Unit, Multiple Unit (# units) |
| Core Coolant | Molten Salts | H2O, D2O, He, CO2, Na, Pb, PbBi, Molten Salts, (Other-specify) |
| Reactor Core Size (1 core) | 30 MWth <= Thermal power < 1000 MWth | e.g. Thermal Power < 30 MWth, 30 MWth ≤ Thermal power < 1000 MWth, 1000 MWth ≤ Thermal power ≤ 3000 MWth, Thermal power > 3000 MWth |
| Reactor Type | MSR | e.g. PWR, BWR, HWR, SCWR, GCR, GFR, SFR, LFR, MSR, ADS |
| Reactor Size | SMR | e.g. PWR, SMR |
| Neutron Moderator | Graphite | e.g. H2O, D2O, He, CO2, Na, Pb, PbBi, Molten Salts, (Other-specify) |
| NSSS Layout | | e.g. Loop-type (# loops), Direct-cycle, Semi-integral, Integral, Pool-type |
| Primary Circulation | Natural | e.g. Forced (# pumps), Natural |
| Thermodynamic Cycle | | e.g. Rankine, Brayton, Combined-Cycle (direct/indirect) |
| Secondary Side Fluid | | e.g. H2O, He, CO2, Na, Pb, PbBi, Molten Salts, (Other-specify) |
| Fuel Form | Liquid Fuel/Coolant | e.g. Fuel Assembly/Bundle, Coated Sphere, Plate, Prismatic, Contained Liquid, Liquid Fuel/Coolant |

| | | |
|---|---|---|
| Fuel Lattice Shape | Hexagonal | e.g. Square, Hexagonal, Triangular, Cylindrical, Spherical, Other, n/a |
| Rods/Pins per Fuel Assembly/Bundle | | e.g. #, n/a |
| Fuel Material Type | Molten Salt | e.g. Oxide, Nitride, Carbide, Metal, Molten Salt, (Other-specify) |
| Design Status | Conceptual Design | e.g. Conceptual, Detailed, Final (with secure suppliers) |
| Licensing Status | | e.g. DCR, GDR, PSAR, FSAR, Design Licensed (in Country), Under Construction (# units), In Operation (# units) |
| Neutron Spectrum | Thermal | e.g. Fast, Thermal |

# 3. Parameter Fields

Table 2: ARIS Parameter Fields

| ARIS Parameter | Value | Units of Examples |
|---|---|---|
| **Plant Infrastructure** | | |
| Design Life | 60 | Years |
| Lifetime Capacity Factor | | %, defined as Lifetime MWe-yrs delivered / (MWe capacity * Design Life), incl. outages |
| Major Planned Outages | | # days every # months (specify purpose, including refuelling) |
| Operation / Maintenance Human Resources | | # Staff in Operation / Maintenance Crew during Normal Operation |
| Reference Site Design | | n Units/Modules |
| Capacity to Electric Grid | 24 | MWe (net to grid) |
| Non-electric Capacity | | e.g. MW(th) heat at x °C, m3/day desalinated water, kg/day hydrogen, etc. |
| In-House Plant Consumption | | MWe |
| Plant Footprint | 450 (single unit), 10000 (20 units) | m2 (rectangular building envelope) |
| Site Footprint | | m2 (fenced area) |

| | | |
|---|---|---|
| Emergency Planning Zone | | km (radius) |
| Releases during Normal Operation | | TBq/yr (Noble Gases / Tritium Gas / Liquids) |
| Load Following Range and Speed | | x – 100%, % per minute |
| Seismic Design (SSE) | 0.3 | g (Safe-Shutdown Earthquake) |
| NSSS Operating Pressure (primary side) | 0.101325 | MPa(abs), i.e. MPa(g)+0.1, at core outlet |
| NSSS Operating Pressure (secondary side) | | MPa(abs), i.e. MPa(g)+0.1, at secondary side outlet |
| Primary Coolant Inventory (incl. pressurizer) | | kg |
| Nominal Coolant Flow Rate (primary) | | kg/s |
| Nominal Coolant Flow Rate (secondary) | | kg/s |
| Core Inlet Coolant Temperature | 725 | ºC |
| Core Outlet Coolant Temperature | 795 | ºC |
| Available Tempeature as Process Heat Source | | ºC |
| NSSS Largest Component | Reactor vessel | e.g. RPV (empty), SG, Core Module (empty/fuelled), etc. |
| - NSSS Largest Component Length | 7500 | mm |
| - NSSS Largest Component Diameter | 6000 | mm |
| - NSSS Largest Component Thickness | | mm |
| - NSSS Largest Component Weight | 100-500 | tonne |
| Reactor Vessel Material | | e.g. SS304, SS316, SA508, 800H, Hastelloy N |
| Steam Generator Design | | e.g. Vertical/Horizontal, U-Tube/ Straight/Helical, cross/counter flow |
| Secondary Coolant Inventory | | kg |

| | | |
|---|---|---|
| Pressurizer Design | | e.g. separate vessel, integral, steam or gas pressurised, etc. |
| Pressurizer Volume | | m3 / m3 (total / liquid) |
| Containment Type | | Dry (single/double), Dry/Wet Well, Inerted, etc. |
| Containment Volume | | m3 |
| Spent Fuel Pool Capacity and Total Volume | | Years of full-power operation / m3 |
| Non Electric Application | | - |
| Core Delta Temperature | 70 | ºC |
| **Fuel/Core** | | |
| Single Core Thermal Power | 60 | MW(th) |
| Refuelling Cycle | 36-60 | months or “continuous” |
| Fuel Material | Molten salt fuel within vented fuel tubes | e.g. UO2, MOX, UF4, UCO |
| Enrichment (avg./max.) | 5 | % |
| Average Neutron Energy | | eV |
| Fuel Cladding Material | | e.g. Zr-4, SS, TRISO, E-110, none |
| Number of Fuel “Units” | | Specify as Assembly, Bundle, Plate, Sphere, or n/a |
| Weight of one Fuel Unit | | kg |
| Total Fissile Loading (initial) | | kg fissile material (specify isotopic and chemical composition) |
| % of fuel outside core during normal operation | | Applicable to online refuelling and molten salt reactors |
| Fraction of fresh-fuel fissile material used up at discharge | | % |
| Core Discharge Burnup | 35 | MWd/kgHM (heavy metal, eg U, Pu, Th) |
| Pin Burnup (max.) | | MWd/kgHM |
| Breeding/Conversion Ratio | | Fraction of fissile material bred in-situ over one fuel cycle or at equilibrium core |

| | | |
|---|---|---|
| Reprocessing | | e.g. None, Batch, Continuous (FP polishing/actinide removal), etc. |
| Main Reactivity Control | Strong fuel temperature coefficient, liquid neutron absorber thermometer | e.g. Rods, Boron Solution, Fuel Load, Temperature, Flow Rate, Reflectors |
| Solid Burnable Absorber | | e.g. Gd2O3 |
| Core Volume (active) | | m3 (used to calculate power density) |
| Fast Neutron Flux at Core Pressure Boundary | | n/(cm²*s) |
| Max. Fast Neutron Flux | | n/(cm²*s) |
| Core Control Rod Absorber | | - |
| Core Soluble Neutron Absorber | | - |
| **Safety Systems** | | |
| Number of Safety Trains | Active / Passive | % capacity of each train to fulfil safety function |
| - reactor shutdown | Passive | - / - / - |
| - core injection | Passive | - / - / - |
| - decay heat removal | Passive | - /- / - |
| - containment isolation and cooling | N/A | - / - / - |
| - emergency AC supply (e.g. diesels) | N/A | - / - / - |
| DC Power Capacity (e.g. batteries) | | Hours |
| Events in which Immediate Operator Action is required | | e.g. any internal/external initiating events, none |
| Limiting (shortest) Subsequent Operator Action Time | | Hours (that are assumed when following EOPs) |
| Severe Accident Core Provisions | | e.g. no core melt, IVMR, Core Catcher, Core Dump Tank, MCCI |
| Core Damage Frequency (CDF) | | x/reactor-year (based on reference site and location) |
| Severe Accident Containment Provisions | | e.g., H2 ignitors, PARs, filtered venting etc. |

| | | |
|---|---|---|
| Large Release Frequency (LRF) | | x/reactor-year (based on reference site and location) |
| **Overall Build Project Costs Estimate or Range (excluding Licensing, based on the Reference Design Site and Location)** | | |
| Construction Time (nth of a kind) | | Months from first concrete to criticality |
| Design, Project Mgmt. and Procurement Effort | | Person-years (PY) [DP&P] |
| Construction and Commissioning Effort | | PY [C&C] |
| Material and Equipment Overnight Capital Cost | | Million US$(2015) [M&E], if built in USA |
| Cost Breakdown | %[C&C]/%[M&E] | |
| - Site Development before first concrete | | (e.g. 25/10 )<br>( 30/40 )<br>( 20/25 )<br>( 20/10 )<br>( 5/15 )<br>( ----------)<br>(to add up to 100/100) |
| - Nuclear Island (NSSS) | | |
| - Conventional Island (Turbine and Cooling) | | |
| - Balance of Plant (BOP) | | |
| - Commissioning and First Fuel Loading | | |
| Factory / On-Site split in [C&C] effort | | %/% of total [C&C] effort in PY (e.g., 60/40 ) |
| **Nuclear System** | | |
| System Steam Flow Rate | | kg/s |
| System Steam Pressure | | MPa |
| System Steam Temperature | | ºC |
| System Feedwater Flow Rate | | kg/s |
| System Feedwater Temperature | | ºC |
| **Reactor Core** | | |
| Active Core Height | | m |
| Equivalent Core Diameter | | m |
| Average Linear Heat Rate | | kW/m |
| Average Fuel Power Density | | kW/kgU |

| | | |
|---|---|---|
| Average Core Power Density | | MW/m3 |
| Outer Diameter Of Fuel Rods | | mm |

# 4. Plant Layout, Site Environment and Grid Integration

## SUMMARY FOR BOOKLET

The FLEX is flexible and can be deployed in different array sizes as demanded by the application. An illustrative FLEX reactor plant layout arrangement would be an array of 20 reactors on the nuclear island, which will provide circa ~1.2 GWth energy which can be converted into ~500 MWe of electrical output. The external GridReserve® storage tanks, turbine hall, electrical sub-station, and potential hydrogen production plant are located outside the nuclear island. This configuration will enable a truly 'hybrid' energy generation, storage, and release scheme.

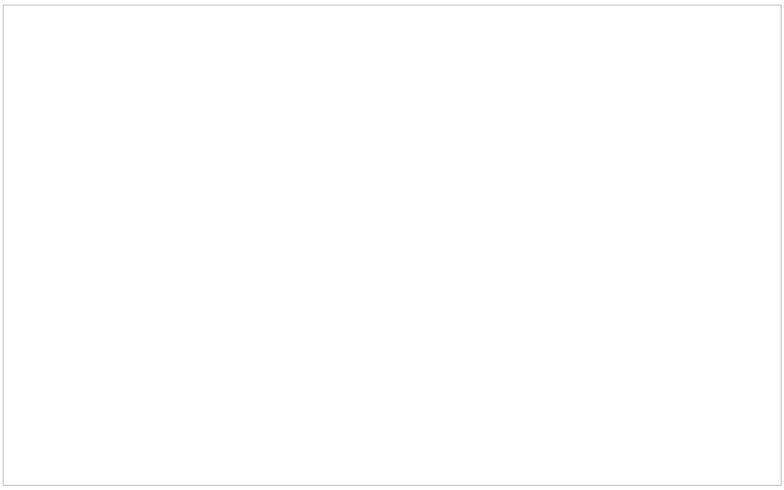


Figure 2. Plant layout

**4.1 Site Requirements during Construction**
**4.2 Site Considerations during Operation**
**4.3 Grid Integration**

# 5. Technical NSSS/Power Conversion System Designn

## SUMMARY FOR BOOKLET

**Power Conversion**

Each FLEX reactor outputs 60 MWth as hot salt at 700°C. This heat can be directly fed to a steam boiler to generate steam at typical subcritical conditions, where there is already a wealth of experience in flexible operation of generating plant, generating ~24 MWe. Alternatively, the heat can be fed to

external thermal storage tanks (located outside the nuclear island), known as the GridReserve® system.

The use of the GridReserve® technology permits electrical generation to follow a dispatched load profile or to operate in a frequency responsive mode. It is also possible to dynamically allocate energy to other heat loads. The ability of one or more FLEX reactor systems to operate with different sizes of GridReserve® means that different energy load profiles are readily accommodated.

**Reactor Core**

The FLEX is a fluoride salt reactor with separate fuel and coolant salts. The patented core design comprises an array of vented fuel tubes in a graphite matrix which fills most of the tank. Each tube sits in a separate channel, and the primary coolant molten salt circulates up through the channel by natural convection. It then flows through a heat exchanger and flows around the core back to the fuel channels. The fuel salt circulates in the fuel tube by natural convection and heat is transferred through the tube wall to the coolant surrounding the tube. The fuel salt does not mix with the coolant salt under normal operation. Under fault conditions the miscibility of fuel and coolant salt fundamentally changes the impact of core damage. In a conventional reactor, core damage can result in the reactor moving to a substantially more hazardous state. In the FLEX, similar scenarios are tolerable since even severe core damage reduces k-eff. Breach of the tube wall results in a reduction in core reactivity as the fuel salt is diluted in the large coolant volume. As a result, core damage does not result in further damage or the loss of further containment barriers.

**Reactivity Control**

In the FLEX, the bulk of the excess reactivity present immediately after fuelling is neutralised through burnable absorber material within the core. Any residual excess reactivity is neutralised by a soluble neutron absorber in the coolant salt, which is added to the primary coolant using a periodic injection system. This neutron absorber burns out slowly and is replenished at intervals of several weeks or months. Fine reactivity control for reactivity changes during power demand shifts is provided by a patented novel mechanism akin to a conventional mercury thermometer, but instead filled with a liquid neutron absorber. The “bulb” of the thermometer sits in the cold coolant salt entering the bottom of the core and the stem extends upwards through the graphite matrix. An increase in heat demand from the reactor causes a drop in primary coolant temperature, cooling the thermometer bulb, which causes the neutron absorber to withdraw down the stem of the thermometer, thereby increasing reactivity. When heat demand is reduced, the temperature of the primary coolant rises, heating the thermometer bulb, driving the neutron absorber up through the stem and into the coolant, reducing reactivity.

**Reactor Vessel and Internals**

The reactor vessel for the FLEX comprises an outer and inner tank, separated by a refractory layer. The outer tank, constructed from a stainless steel, will serve as the primary structural vessel for the reactor core and primary coolant loop. The inner tank, also constructed from a stainless steel, will serve as the liner to contain the primary coolant salt at temperatures above 700°C, and is designed to accommodate radial expansion. The refractory layer will act as the insulation layer for the inner tank, whilst also providing neutron irradiation shielding to the outer tank. The inner and outer tank vessels are placed in a concrete pit underground and covered from the top with a lid containing plugs for refuelling. A concrete shield covers the lid.

**Fuel Characteristics**

The fuel is 5% enriched uranium within a mixture of UF3, UF4 and NaF molten salt, which is contained at low pressures by the patented vented fuel tube. The fuel expands when it is heated, contributing towards the fuel salt's negative temperature coefficient.

**Fission Product Management**

Many of the fission products that would often form gases in other reactors, notably iodine and caesium, are immediately captured as non-volatile salts and remain contained in the fuel salt within the fuel tube. The major releases are the Xe and Kr noble gases, and the great majority of the radioactive species decay within the tube. The top of the fuel tube contains a 'bubbler' assembly, which is essentially a series of molten salt gas traps. This limits the speed at which fission gases can reach the reactor gas space and primary coolant, allowing them time to decay. This significantly reduces the ability of 135Cs, a long-lived fission product, to contaminate the coolant salt.

**Instrumentation and Control System**

Instrumentation includes ex-core flux detectors for commissioning and startup, as well as regular physics tests (at least on early cores). An array of thermocouples are located above the fuel assemblies to detect the outlet temperature. Thermocouples are placed in the cold leg of the heat exchangers. Level sensors determine the coolant salt level within the core. Radiation detectors are present in both primary and secondary heat exchangers to determine whether fuel to coolant or primary to secondary leaks have occurred. Thermocouples are present on the outer tank to determine whether a breach in the inner tank has occurred. The reactor power is entirely regulated by the primary heat exchanger demand as the system passively load-follows in normal operation. During commissioning and refuelling, an electric heater array underneath the core provides sufficient heat to match/exceed the RHRS and maintain/increase the core temperature. There is also a periodic coolant poison injection system to trim the reactivity as the fuel burns up. This can also deliver a 'lethal dose' of poison if necessary to permanently shut down the reactor.

**5.1 Primary Circuit**
**5.2 Reactor Core and Fuel**
**5.3 Fuel Handling**
**5.4 Reactor Protection**
**5.5 Secondary Side**
**5.6 Containment/Confinement**
**5.7 Electrical, I&C and Human Interface**
**5.8 Unique Technical Design Features (if any)**

# 6. Technology Readiness

# SUMMARY FOR BOOKLET

**Testing Conducted for Design Verification and Validation**

Current testing is focused on materials & corrosion, confirmation of thermo-physical properties of salts for use in modelling, and thermohydraulic tests. MoltexFLEX has established its own laboratory and is running a range of corrosion and materials compatibility tests, alongside thermophysical properties tests. Industrial and academic partners are supporting MoltexFLEX. The FLEX reactor is currently at TRL 2, and is close to TRL 3. A number of test rigs are planned to move the design to TRL 4 by summer 2027. The TRL assessment and plan to achieve this has been independently verified by three recognised experts in the UK nuclear industry.

**Design and Licensing Status**

Early engagement with UK nuclear regulators has been initiated and the first session is being scheduled. A number of potential sites are under consideration and discussions are ongoing.

### 6.1 Deployed Reactors
### 6.2 Reactors under Licensing Review
### 6.3 Reactors in the Design Stage

# 7. Safety Concepts

# SUMMARY FOR BOOKLET

**Engineered Safety System Approach and Configuration**

The design philosophy adopted is to follow the internationally accepted principle of the risk mitigation pyramid. The focus is to eliminate hazards wherever possible, to use inherent and passive safety features where this is not possible, and only to rely on engineering or administrative controls when that cannot be achieved. As a result the core has no moving parts or active control systems.

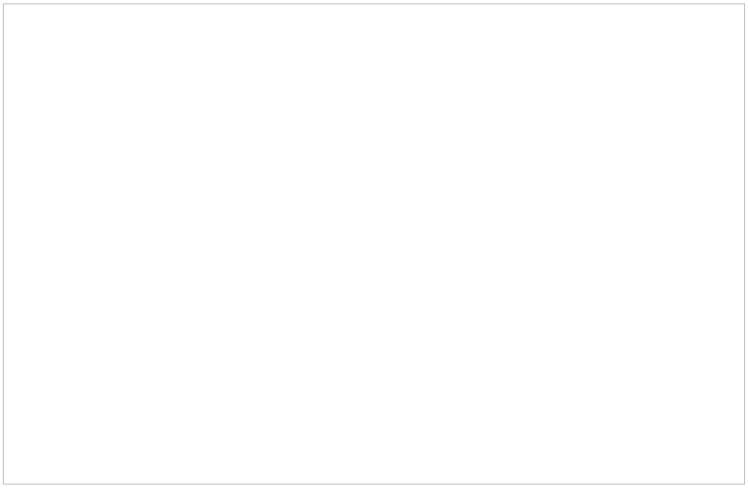


Figure 3. Risk mitigation pyramid

**Decay Heat Removal System**

The decay (or residual) heat removal system (RHRS) is completely passive and utilises natural convection with no need for mechanical components. Utilising an arrangement of ducts around the reactor tank, it promotes air cooling of the base and side walls of the reactor tank, drawing cool air down and around the external tank walls and exhausting the heated air to the reactor building.

**Emergency Core Cooling System**

A traditional Emergency Core cooling system is not required for the FLEX reactor as the design ensures that the core is kept submerged by the coolant and never exposed, and decay heat is removed by convection as previously explained.

**Containment System**

Containment is progressively provided by the fuel tube, the inner tank, and the outer tank. Shielding is provided by the pit walls and the concrete biological shield. The salt chemistry of the fuel/coolant immobilises some otherwise volatile fission products.

**Chemical Control**

The FLEX has distinct fuel and coolant chemical environments. The fuel salt chemistry is very simple and is redox stabilised by a mixture of uranium oxidation states acting as a buffer in a eutectic mixture with sodium fluoride diluent. The redox buffer enables maintenance of redox potential and mitigation of potentially corrosive fission products generated through life. The primary coolant is also a fluoride eutectic. Tritium production is mitigated by eliminating lithium from the chemistry. Similarly, beryllium is also eliminated to prevent highly corrosive and toxic environments. The primary coolant salt is compatible with graphite and mixes safely with the fuel salt. Corrosion of reactor components by the coolant salt is managed using reducing agents. Moltex has been operating a laboratory since 2021. It is set up to deliver on salt manufacturing for both fuel and coolant, alongside corrosion trials, thermophysical properties and test rigs. Significant progress has been made in the understanding of the fluids within the system and the demonstration of their compatibility with structural materials..

**Spent Fuel Cooling Safety Approach / System**

Once the FLEX's fuel is depleted, the reactor is put into the standby state before the fuel is removed

from the reactor. During this period, there is no requirement for additional cooling systems. The normal heat transfer systems are disengaged and the decay heat removal system, as described in (b), provides sufficient heat removal until the fuel is ready for extraction.

**Plant Safety and Operational Performances**

The design philosophy is such that there will be very limited operational requirements to attend the nuclear island during each fuel cycle. The significant reduction in the quantity of engineered safety and component systems will also substantially reduce the number of operating staff required for maintenance.

The FLEX can passively ramp up and down in output, but Moltex considers the use of GridReserve® a better and more economical option for the provision of flexible electricity generation. The FLEX reactor system can be designed to operate at full output throughout the 3-5 year fuel cycle.

### 7.1 Safety Philosophy and Implementation
### 7.2 Transient/Accident Behaviour

# 8. Fuel and Fuel Cycle

# SUMMARY FOR BOOKLET

**Fuel Cycle Approach**

The FLEX operates on a three-batch refuelling cycle with a cycle length of 2-5 years. Interim storage of spent fuel will be in multi-purpose dry storage cannisters on site until site decommissioning. The proposed spent fuel management route is geological disposal, but it may be possible to recycle the waste in a fast spectrum reactor.

**Waste Management and Disposal Plan**

Moltex is developing the design to be consistent with international good practice for waste management and spent fuel, aligned to the IAEA. The reactor system itself is being developed to design out as much operational, refuelling, and decommissioning waste as is reasonably practicable. The waste hierarchy is superimposed across the design process, by first seeking to avoid waste creation, and then minimising the category of unavoidable waste. Moltex envisages minimal waste production during normal operation of the FLEX. Argon 41 is likely to be generated as a by-product of the RHRS; however, this is unlikely to approach the argon discharge limits. Refuelling will generate argon, krypton & other gaseous wastes, but these will not exceed their designated discharge limits. A small amount of solid waste will be produced through spent fuel, which can be stored in multi-purpose cannisters on site until decommissioning. Decommissioning will produce solid, liquid, and gaseous wastes, the largest proportion of which will be graphite. Moltex seeks to recycle and re-use graphite wherever possible in new FLEX reactors.

8.1 Fuel Cycle Options
8.2 Resource Use Optimization
8.3 Unique Fuel/Fuel Cycle Design Features

## 9. Safeguard & Physical Security

## SUMMARY FOR BOOKLET

9.1 Safeguards
9.2 Security
9.3 Unique Safeguards and/or Security Features

## 10. Project Delivery & Economics

## SUMMARY FOR BOOKLET

10.1 Project Preparation and Negotiation
10.2 Construction and Commissioning
10.3 Operation and Maintenance