# MSRs for TRU Transmutation

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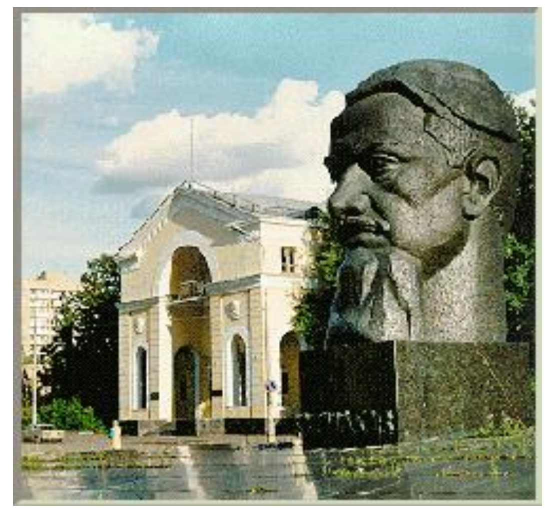

# RUSSIAN NUCLEAR POWER PLANTS: 37 NUCLEAR POWER UNITS, 30 GW.
# THEY PRODUCE 18,9 % OF THE ELECTRICITY GENERATED IN THE COUNTRY.

- VVER-1000/1200: 15 units (13 units VVER-1000 + 2 units VVER-1200) in operation
  - 6 units under construction (Baltic NPP -2 units, Kursk NPP -2 units, Novovoronezh NPP-1, Leningrad NPP-1 unit )
- RBMK-1000: 11 units in operation
- VVER-440: 5 units in operation till 2030, 3 units are in the course of decommissioning
- EGP-6: 4 units in operation, decommissioning is scheduled for 2019-2021
- BN-600 (FR) 1 units in operation
- BN-800(FR) 1 unit in operation
- FTNPP 1 unit - "Academician Lomonosov"
- will replace Bilibino NPP (shout down in 2019-2021 years)
- Research reactors Ice-breakers
- Submarines

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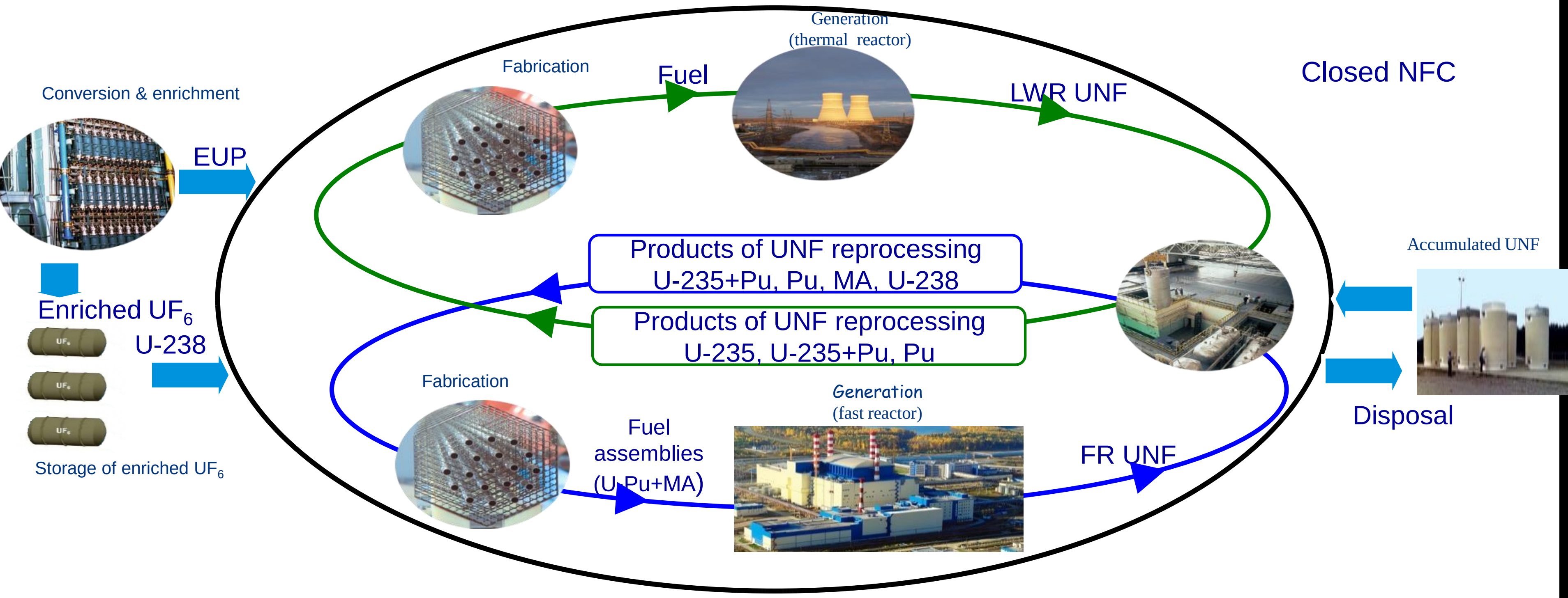
# TWO COMPONENT NUCLEAR POWER SYSTEM

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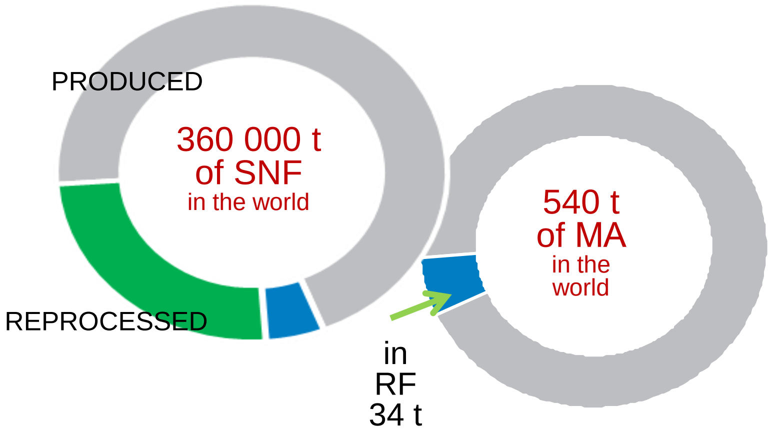
# UNF infrastructure in Russian Federation

Facilities of Test Demonstration Centre being built at the site of the Mining and Chemical Combine after 2020 will start reprocessing of UNF from VVER-1000, providing a recovered fissile materials for recycling in thermal and fast reactors.

TDC will become the reference basis for the large-scale RT-2 plant, which will provide an environmentally and economically acceptable system of VVER-1000/1200 UNF recycling both in Russia and abroad.


In accordance with today TDC flowsheet, the HLW, containing Am and Cm is the subject for vitrification 3

# *ONE OF THE MAIN PROBLEMS OF NUCLEAR ENERGY IS PRODUCING OF LARGE AMOUNTS OF RADIOTOXIC SPENT NUCLEAR FUEL (SNF)*




The main part of SNF radiotoxity is inserted by long-lived actinides (MA): $^{237}$Np, $^{241,243}$Am, $^{244,245,247,248}$Cm.

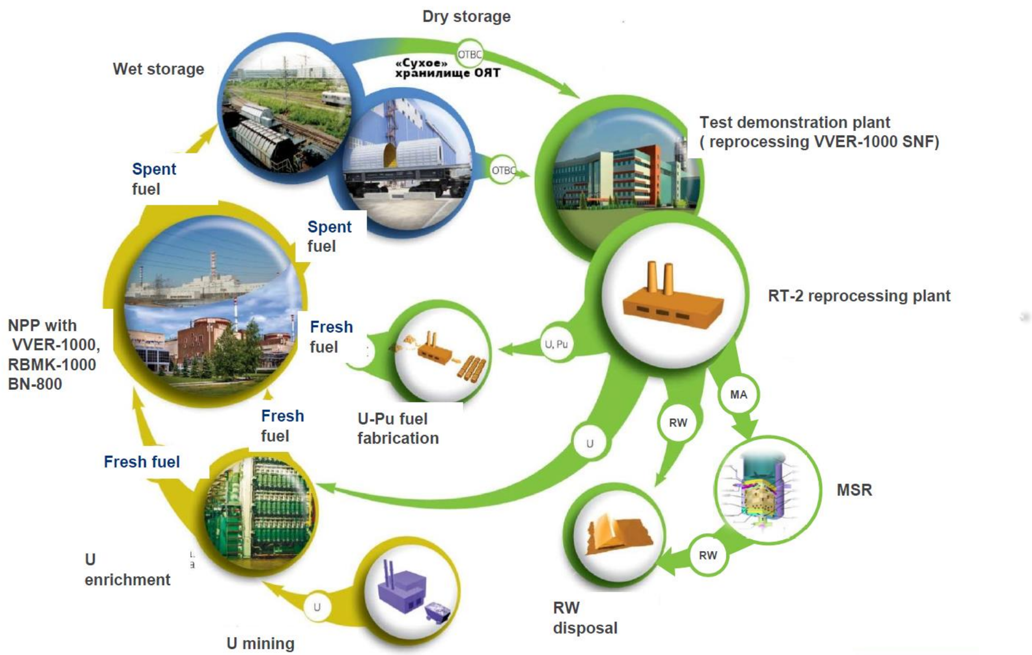
The attractive idea – MA transmutation.

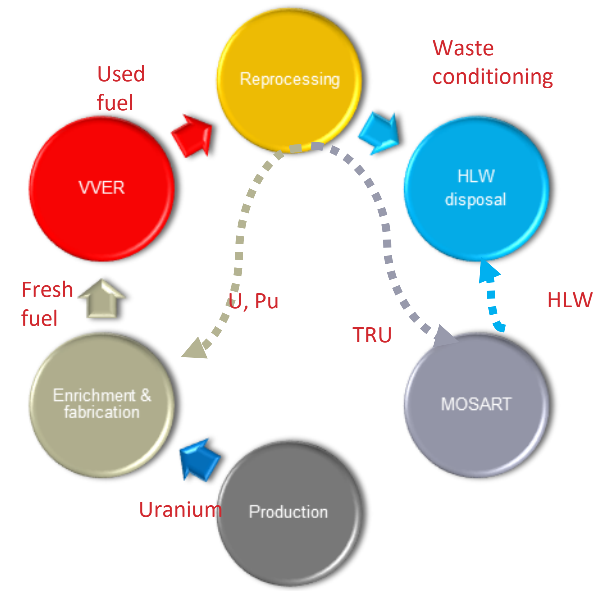
The possibility of MA excluding from High Level Wastes (HLW) which are sent to vitrification and then to disposal can give some benefits:

- ✓ Decrease the volume of HLW (after SNF reprocessing) approximately in 70 times;
- ✓ Decrease the time of HLW potential danger from 10 000 to 300 years ;
- ✓ In perspective except the necessity in vitrifired HLW disposals ;

The main benefit of MA transmutation is increasing of Nuclear Energy public acceptability.

# *The Russian Federation: SNF management*




Large-scale RT-2 plant will reprocess 250 t of SNF every year → and produce 300 kg of MA

*It is proposed to use the technical and technological capabilities of the MCC site to place MSR-transmutor in the immediate vicinity of SNF reprocessing facilities, linking it to the EDC infrastructure.*

“Rosatom” supported MSR activities to be focused to the 2400 MWt Li,Be/F based MOSART design

# BENEFITS FOR MA/TRU BURNING IN MOLTEN SALT REACTORS

- Overcoming the difficulties of solid fuel fabrication / re-fabrication with large amounts of transuranic elements (TRU);
- Fuel make up (fertile/fissile) without shutting down the reactor;
- On-line fission-product removal using physical (inert gas sparging) and pyrochemical processes;
- Thermal expansion of fuel salt provides strong negative temperature reactivity coefficient in homogeneous core;
- Better resource utilization by achieving high fuel burn-up;

The fuel cycle of the EDC technological complex (Reprocessing Plant + MSR-transmutor) will be organized as the following :

The bulk of the removed uranium and plutonium return to thermal and fast solid fuel reactors

Remaining Pu+MA are transferred for utilization in the MOSART system;

Vitrified Fission Products are send to disposal;

*The co-location of MOSART and SNF reprocessing plants, will provide the complex and the surrounding by electricity, facilitates the problems of nuclear materials transport and radwaste management.*

# *Selection of Main Design Characteristics for MOlten Salt Actinide Recycler & Transmuter (MOSART)*

*The main criteria for MOSART design selection:*

- *the ability to work with fuels of various nuclide composition without reactor shutdown and special modifications of the core;*
- *the ability to maintain the inherent safety features of the reactor when changing the fuel composition;*
- *the minimum possible actinides losses in multiple recycling;*
- *the possibility to burn near 250-300 kg/year of MA produced on EDC.*

*The conceptual design must be created in the margins of technological limits.*

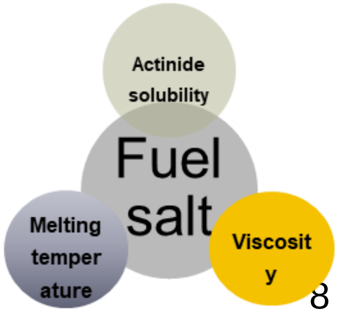
*Components and the materials of the reactor must have high level of readiness for utilization - right now or in the nearest feature.*

| | |
|---|---|
| Fuel salt, mole% | $LiF$-$BeF_2$+$TRUF_3$ |
| Temperature, °C | 620-720 |
| Core radius/height, m | 1.4/2.8 |
| Core specific power, W/cm³ | 75 |
| Container material | kHN80MTY alloy |
| Removal time for soluble FP, yr | 1-3 |

| Solvent, mole % | Feed MA/TRU | Loading (EOL), t | TRU/MA, kg/yr |
|---|---|---|---|
| 73LiF-27$BeF_2$ | 0.1 | 3.9 | 730/73 |
| 15LiF-58NaF-27BeF2 | 0.1 | 7.7 | 730/73 |

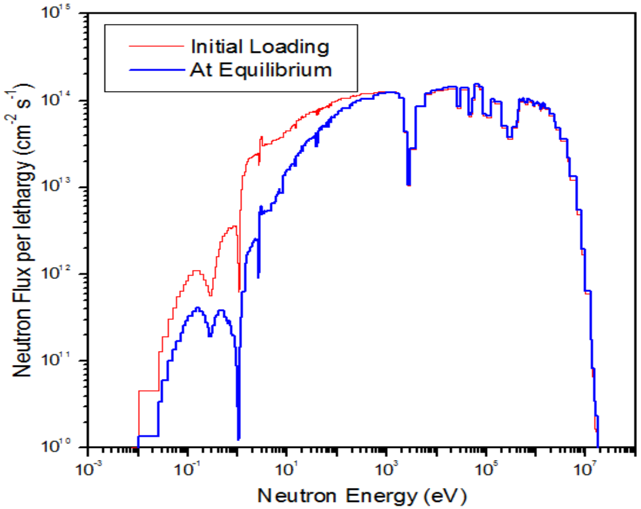


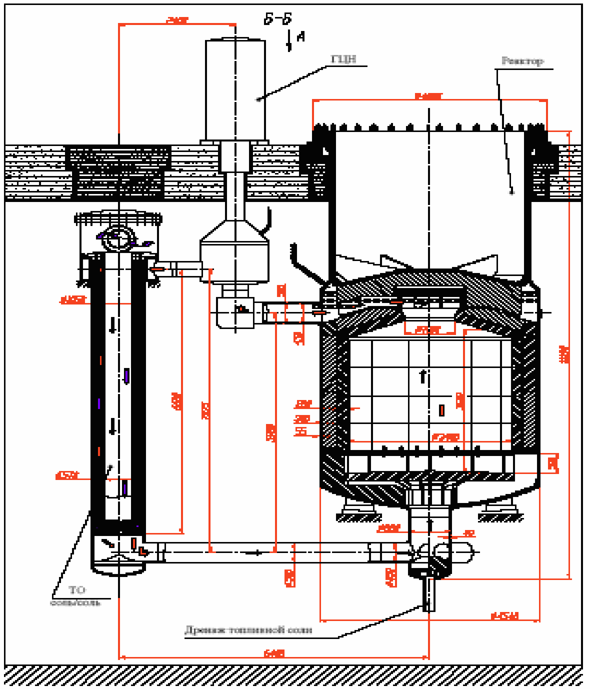
Different MOSART design options with homogeneous core and different fuel salts with high enough solubility for TRU were examined.



# 2400MWt MOSART

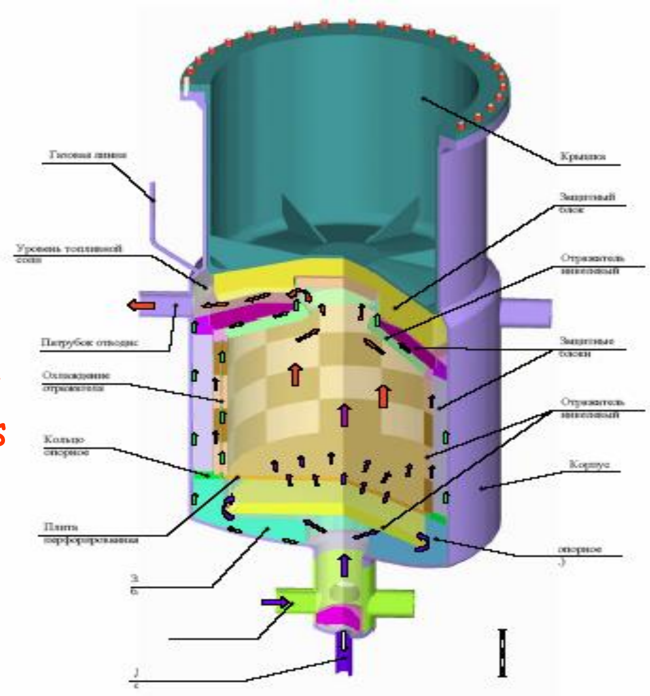
•Configuration for 2400 MWt MOSART is the homogeneous cylindrical cor (3.6 m high and 3.4 m in diameter) with 0.2 m reflector filled by 100 % of molten 73LiF-27BeF2 salt mixture. The effective flux of such system is near 1x1015 n/cm2 /s.



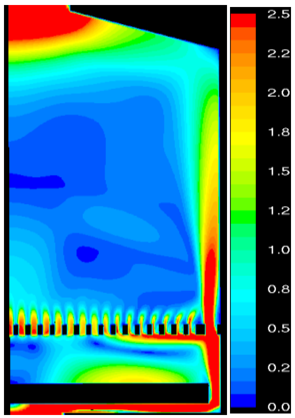
MOSART has all positive features of the homogeneous molten salt reactor without graphite: large negative temperature reactivity coefficients and strongly reduced reprocessing rate

• Basis for MOSART concept is the use of Li,Be/F solvents with 27->25 mole% BeF2 and its adequate solubility for AnF3 (2->3 mole% at 600C)

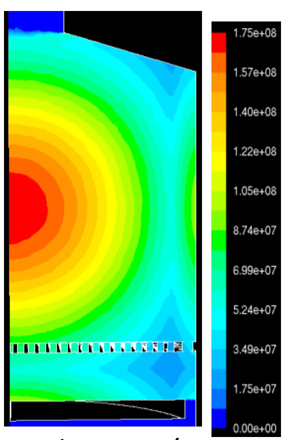


It is feasible to design critical homogeneous core fuelled only by transuranium elements (TRU) trifluorides from UOX (MA/TRU =0.1) or MOX LWR (MA/TRU =0.2) spent fuel while equilibrium concentration for trifluorides of actinides (about 0.45-1 mole% for the rare earth removal cycle 300 epdf) is truly below solubility limit at minimal fuel salt temperature in primary circuit 600oC.

# THE MOSART CONCEPT




*Heat source, W/m$^3$*




*Velocity, m/s*

The performed calculations show that the Li,Be/F MOSART, starting at TRU from SNF of VVER with the ratio of MA to (Pu + MA) equal 0.1, without core modification and changing temperature in the fuel circuit, can use any TRU make up with the MA to (Pu + MA) ratio up to 0.33. At equilibrium $^{245}$Cm fission contribute 28 % to the core reactivity. This allows 2.4 GWt MOSART with a fuel salt of the selected composition to utilize up to 250 kg of MA per year.

Fuel salt clean up for Li,Be/F MOSART system could be based on the reductive extraction in liquid bismuth.

Optimized configuration of homogeneous core meets most important safety issues: (1) areas of reverse, stagnant or laminar flow are avoided, (2) max temperature of solid reflectors was minimized and (3) temperature coefficients of reactivity in core with 0.2 m reflector in the range 900-1600K are strongly negative (– 4.0 pcm/K ).

| | |
|---|---|
| **Thermal Power, MWt** | **2400** |
| **Electric Power, MWe** | **1100** |
| **Productivity for MA burning, Kg/year** | **up to 250** |
| **Salt volume in the core, m$^3$** | **30.4** |
| Salt volume in the reactor, m$^3$ | **48.4** |
| **Neutron Flux in Fuel Salt, n/sm$^2$ s$^{-1}$** | **1x10$^{15}$** |
| **Fuel Salt** | **$^7$LiF - BeF$_2$** |
| **BOL loading , t** | **3.5** |
| **EOL loading (influenced by** MA/(Pu + MA) ratio in **the feeding), t** | **3.6-18.2** |
| **MA burned from the beginning to MA introduced from the beginning for 50 years of reactor operation, %** | **70** |



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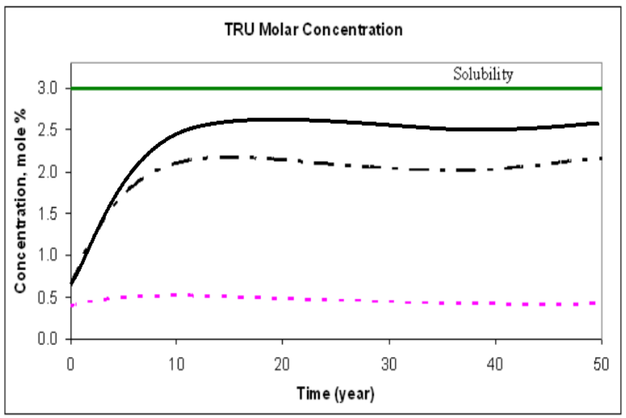
# MOSART initial loading - 11% MA+89% Pu; make up any mixture up to 33,3% of MA+66,7%Pu;

# MOSART consume 13,6 t MA (270 kg/yr) after 50 years

Input in $K_{eff}$

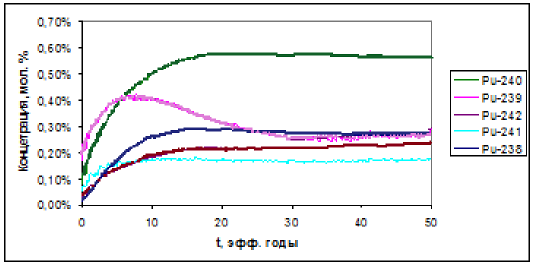
| ISOTOPE | BOL | EOL |
|---|---|---|
| Pu 239 | 0,75 | 0,25 |
| Pu 241 | 0,25 | 0,41 |
| Cm 245 | - | 0,28 |

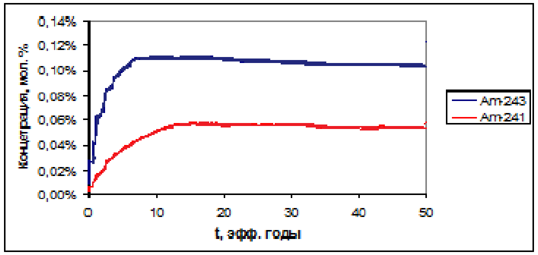


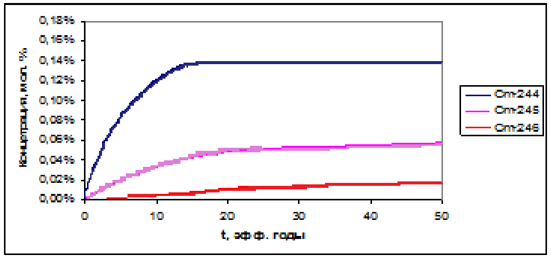

Feeding composition (Np+MA)/TRU=0.35

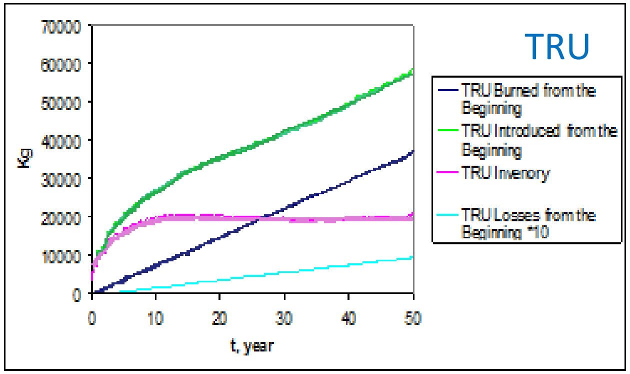
Feeding composition (Np+MA)/TRU=0.1

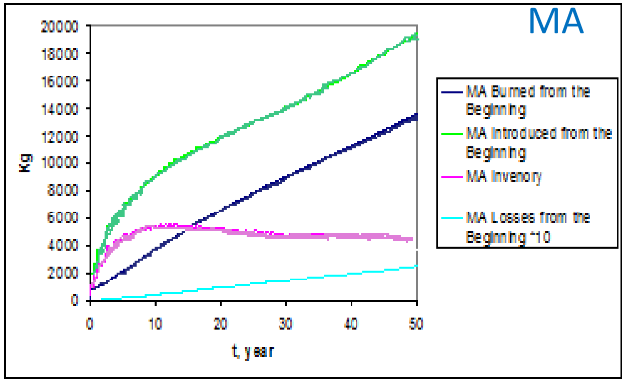
Feeding composition (Np+MA)/TRU=0.45 (with U-233 recycling from blanket to fuel stream).



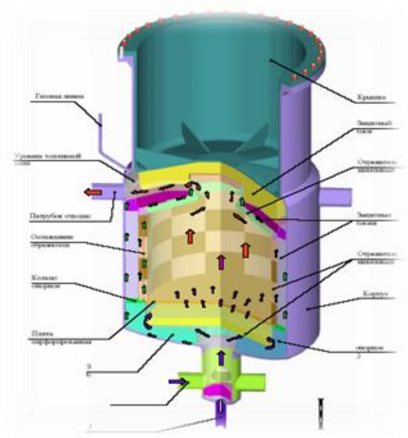



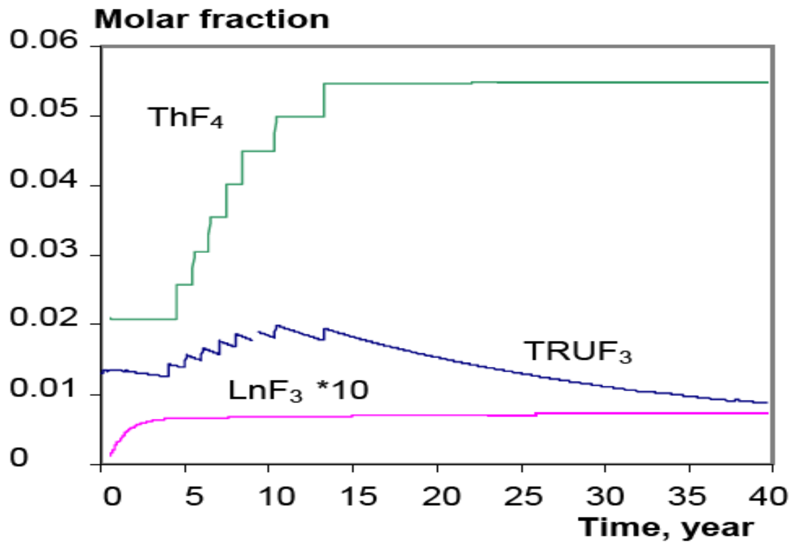
# MOSART –Transforming Reactor System

*MOSART started with TRU's Fluorides from LWR used nuclear fuel has flexible fuel cycle and can operate in different modes:*

- *Transmuter*
- *Self-sustainable*
- *Breeder*



| *System* | *Burner* / | *Breeder* |
|---|---|---|
| *Fluid streams* | *1* | *2* |
| *Power capacity, MWt* | *2400* | *2400* |
| *Fuel salt inlet/outlet temperature, ºC* | *600 /720* | *600 /720* |
| *Fuel salt composition, mole %* | *72LiF $27BeF_2$ $1TRUF_3$* | *75LiF $16.5BeF_2$ $6ThF_4$ $2.5TRUF_3$* |
| *Blanket salt composition, mole %* | *no* | *75LiF $5BeF_2$ $20ThF_4$* |




- Single fluid 2400MWt MOSART core, containing as initial loading 2 mole % of ThF4 and 1.2 mole % of TRUF3, with the rare earth removal cycle 300 epdf after 12 years can operate without any TRUF3 make up basing only on Th support as a self-sustainable system.

- At equilibrium molar fraction of fertile material in the fuel salt does not exceed 6 %.

# Methods for Fission Product Removal and Actinides Recycling in MOSART Fuel Processing System

*For MOSART that propose chemical reprocessing to remove fission products, the required fuel on-line maintenance operations will include:*

•Continuous removal of Xe and Kr by the He sparging. Stripping of krypton and xenon makes possible their continuous removal from the reactor circuit by the purely physical means of stripping with helium.

•Addition of TRUs to replace that lost by burnup,

•Recycling of all actinides,

•Production of some $UF_3$ to keep the redox potential of the fuel at the desired level,

•Removal of soluble FPs (principally rare earths);

*they probably also include*

•*Partial removal of noble and seminoble metals. The behavior of these insoluble fission-product species is not understood in detail. If they precipitate as adherent* deposits on the MOSART heat exchanger, they would cause no particularly difficult problems. In any case *insoluble fission-product species could probably be usefully removed by a small bypass flow through a relatively simple Ni based-wool filter system.*

| Element | Time |
|---|---|
| Kr, Xe | 50 s |
| Zn, Ga, Ge, As, Se, Nb, Mo, Ru, Rh, Pd, Ag, Tc, Cd, In, Sn, Sb, Te | 2-4 hrs |
| Zr | 1-2 yrs |
| Ni, Fe, Cr | 1-2 yrs |
| Pu, Am, Cm, Np, U | 1-2 yrs |
| Y, La, Ce, Pr, Nd, Pm, Gd, Tb, Dy, Ho, Er | 1-2 yrs |
| Sm, Eu | 1-32yrs |
| Sr, Ba, Rb, Cs | 5-10 yrs |
| Li, Be | 30 yrs |

| | Separation factors related to Plutonium | | |
|---|---|---|---|
| | $LiF-BeF_2/Bi$ | $LiF-BeF_2-ThF_4/Bi$ | $LiF-NaF-BeF_2/Bi$ |
| Pu | 1 | 1 | 1 |
| Am | - | 1,5 | - |
| Cm | 6 | 8 | - |
| Nd | 3000 | 1500 | 100 |
| La | 25000 | 2300 | > 300 |

# *FUEL CHEMICAL PROCESSING IN MOSART FUEL PROCESSING UNIT*

After xenon and krypton are effectively removing , the most important fission products poisons are lanthanides which are soluble in the fuel.

Since actinides must be removed from the fuel solvent before rare earth's fission products the MSR must contain a system that provides for removal of all actinides from the fuel salt and their reintroduction to the fresh or purified solvent.

This *fuel processing system can be based* principally on three types of operations: *removal of actinides, rare earths, and other fission products from the salt by extraction into molten bismuth.*

*The chemical basis on which the processing system is founded is well established* (the coefficients of the distribution of actinides and lanthanides in the Li,Be/F - liquid bismuth system with respect to plutonium at T = 873 K are respectively 6 for curium, 3.000 for neodymium and 25.000 for lanthanum); *however, only small engineering experiments have been carried out to date, and a considerable engineering effort remains.*

# SAFETY APPROACHES

Several fundamental approaches stipulated in GIF safety design criteria (SDC) are implemented in the MOSART design, namely:

- continuous implementation of the defense-in-depth principles;
- maximum strengthening of inherent safety features and preferential use of passive safety systems;
- combination of deterministic and probabilistic approaches to the safety analysis.

The measures adopted in the 2400 MWt MOSART design should minimize :

- occurrence of severe beyond design basis accidents with large-scale core / fuel circuit damage;
- leakages of radioactive fuel salt.

# MSR safety features

The radiation safety of MSR is determined by reliable retention of the fuel and fission products within the primary circuit and by an effective system for fuel salt processing.

Playing an important role is the capacity of the fuel salt to retain many dangerous radionuclides by means of stable bonds in a wide range of variation of the physical parameters in accidental and normal operation modes.

Indeed, some FPs are soluble and thus are kept in the melt. Others, that are volatile, could been removed from fuel during operation.

An's and a main fraction of the FP's, including Cs and I, form in the fuel salt chemically stable soluble compounds, and in the case of primary circuit depressurization of they remain in the fuel, whose vapor pressure is low (<10 Pa at 800°C);

Sometimes the critics of the MSR say that the use of liquid fuel means the loss of safety barrier (fuel cladding)

The numbers of barriers is not a magic number. What is of real importance is a reliability of barriers. And if one wants to keep a number of barriers, why shouldn't we to put an additional guard vessel for fluid fuel reactor?

# MSR safety features

- Thermal expansion of the liquid fuel provide a negative temperature coefficient of reactivity over the fuel even in the presence of a positive Doppler reactivity coefficient;
- The liquid nature of fuel eliminates problems associated with loss of coolant;
- Thermal stresses and accumulation of defects in the fuel accompanying a change in power are eliminated;
- Heat transfer from the fuel salt to intermediate coolant is outside the neutron field, and the fuel–coolant interface does not affect the neutronic processes in the core;
- The chemical interaction of the fuel salt with the intermediate coolant as well as with the air and water is not accompanied by a release of heat and formation of hydrogen as result of exothermic reactions;
- Radiation damage to the fuel is eliminated, since the radiation resistance of fluoride melts is $10^5$ times higher than that of water;

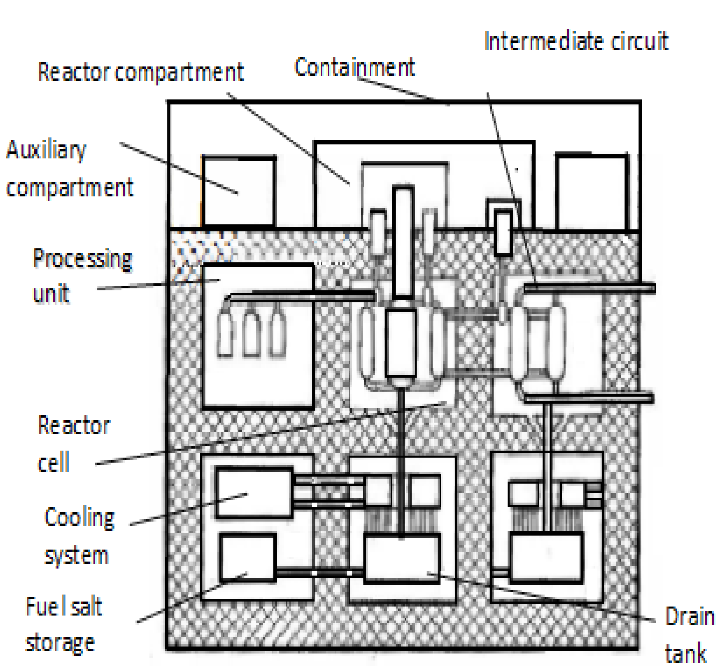
# MSR safety features

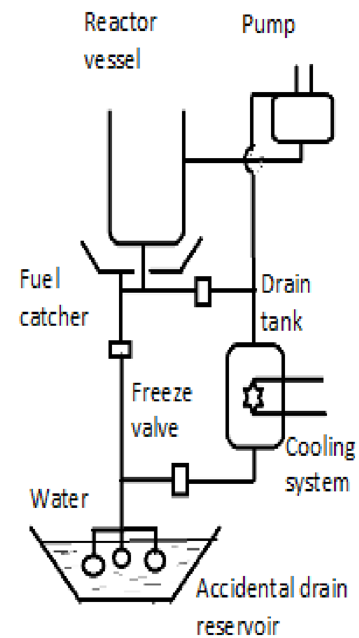
- Low concentration of the actinides fluorides (2-3 mol.%) in the fuel salt and its large margin relative to the saturation temperature (about 600°C) ensure that the thermal reservoir of the primary circuit has a significant capacity and that transient processes proceed without sharp changes of temperature;
- Good physical properties of the liquid fuel make it possible to organize efficient heat removal based on natural circulation with maximum temperature in the primary circuit below 800°C in the case, where the power density of the fuel salt due to decay heat reaches 7–8 MW/m$^3$;
- the basic procedure for reactor shutdown during prolonged stoppages consists in discharging the fuel salt under gravity into subcritical drain tanks, the decay heat from which is removed by continually controlled passive means;
- the liquid fuel makes it possible in principle to eliminate a need for reactivity excess required for reactor startup, which can be accomplished by preheating the fuel salt in the subcritical drain tanks up to the working temperature and then filling the primary circuit containing the core

# Comparison of safety features

| Desired feature : ( "+" for presence; "-" for absence) | Reactor type | | | |
|---|---|---|---|---|
| | MSR | LWR | HTR | LMR |
| Low reactivity margin | + | - | - | - |
| Low non-nuclear energy stored | + | - | +/- | - |
| Low pressure in fuel | + | - | - | - |
| Low pressure in primary circuit | + | - | - | + |
| Low concentration of gaseous products | + | - | - | - |
| Large temperature margins for phase transition in fuel and coolant | + | - | + | + |
| Large heat capacity of fuel | + | - | + | - |
| Cooling down whilst pumps failure | + | + | + | + |
| No local overheat on 1st circuit walls | - | + | + | + |

## In a MSR following safety barriers can be provided : fuel salt as chemical confinement of radionuclides, the wall of the primary circuit, two walls of protective boxes, and an containment shell



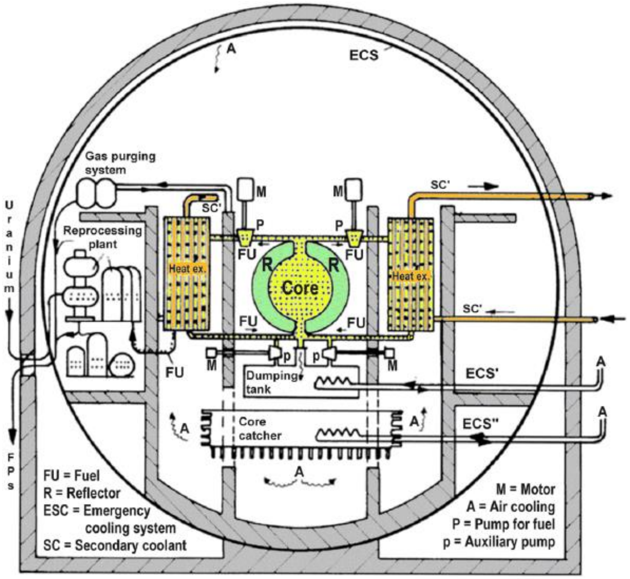

$t = 20\ min$

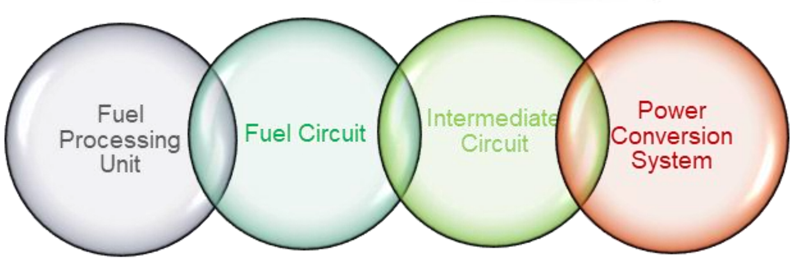
- Two independent safety systems based on (1) control rods and (2) fuel salt transfer to subcritical drain tanks are envisaged in different MSR designs
- The reactor and containment must be designed so that the fuel salt that is heated by decay heat reaches the drain tank under any credible accident conditions.

# MSRE experience

- Keeping salt molten was not difficult
- Moving salt among tanks was routine
- No salt leaks during operation (corrosion as expected)
- Adding enriching salt during operation was uneventful
- Static nuclear properties were accurately predicted
- Excellent dynamic stability with both $^{235}U$ and $^{233}U$ as predicted
- Reactivity change with time was as expected
- Heat transfer and hydraulic performance as predicted
- No pump maintenance required
- Stripping of noble gas fission products was effective
- Effective oxide stripping. Good $UF_6$ recovery

# MOSART Engineered Safety Features




- Nuclear fuel is a fluid. It circulate throughout the reactor coolant system, transfers heat to heat exchanger and becoming critical only in core
- Possible initiators of reactor coolant system breach accident: pipe failure missiles, and pressure or temperature transients in reactor coolant system, failure of the boundary between the 1st and 2nd salts in heat exchanger
- Problem of developing reactor coolant system which will be reliable, maintainable, inspectable over the plant's lifetime will probably be key factor in demonstrating ultimate safety and licencebility
- MSR must be designed so that decay heated fuel salt reaches the drain tank under any credible accident conditions

# Transients analyzed for MOSART

Four basic transients have been analysed for the MOSART concept:

- An Unprotected Loss of Flow (ULOF), assuming loss of forced circulation in the primary system due to pump failure. The core inlet temperature is assumed to remain constant. The mass flow rate of the fuel salt is assumed to stabilize after 7 seconds at about 4% of its nominal value (natural convection);
- An Unprotected Loss of Heat Sink (ULOH) in which the heat sink is assumed to totally fail.
- An Unprotected primary circuit Overcooling transient, with the inlet temperature reduced by 100C in 60 seconds.
- Several Unprotected Transients Over Power (UTOP) due to a +200 and a +500 pcm reactivity insertion. This transients can be initiated by a particle becoming dislodged from the walls of the loop (fissile fuel agglomeration due to precipitation) or staff mistake. MOSART operation would require routine additions of fresh fissile fuel in the amount of about 20 kg per week. The fissile material in the processing systems amounts is about 1% of the reactor inventory. If these materials could be added to the reactor, the excess reactivity would be increased up to 500 pcm or even less.

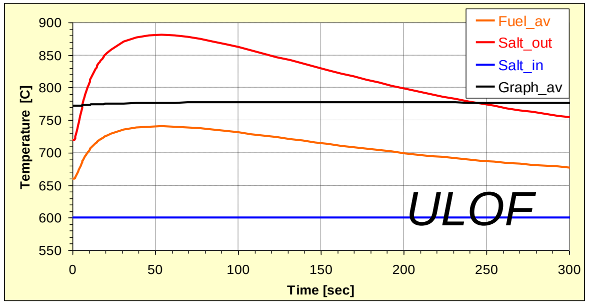
The core inlet temperature is assumed to remain constant during all UTOP transients.

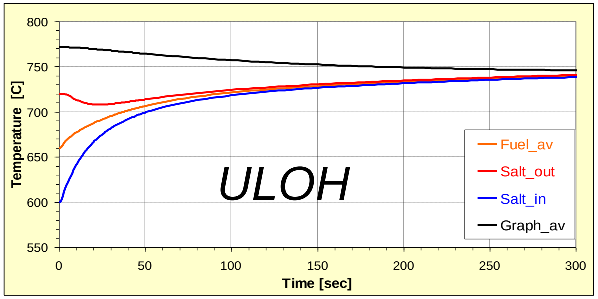
## MOSART main reactivity and kinetics p

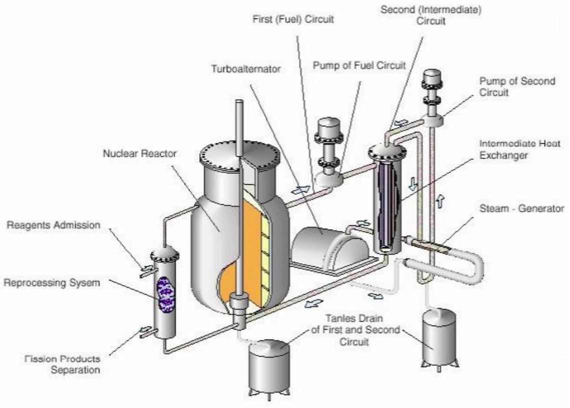
| | BME MCNP4C +JEFF 3.1 /1D172 gr. +JEFF 3.1 /MCNP4C +JEF 2.2 | FZK 2D 560 gr. JEFF 3.0 /JENDL3.3 /ENDF 6.8 /JEF 2.2 | NRG MCNP4C JEFF 3.1 /JEFF 3.0 | Polito 2D 4 gr. JEFF 3.1 | RRC-KI MCNP4B +ENDF5,6 /MCU+ MCUDAT | SCK•CEN MCNPX250 JEFF 3.1 |
|---|---|---|---|---|---|---|
| α-total, pcm/K | -3.86 | -3.86 /-3.82 /-3.86 | -3.75 | -3.78 | -3.71 /-3.41 | -3.66 |
| α-Doppler, pcm/K | /-1.67 | -1.52 /-1.53 /-1.46 | -1.42 | -1.73 | -1.62 /-1.09 | -1.69 |
| α-reflector, pcm/K | -0.05 | -0.05 | | -0.04 | | |
| β-eff, pcm (static) | | 340 | 323±4.4 /294.3±4.6 | | | 320±10 |

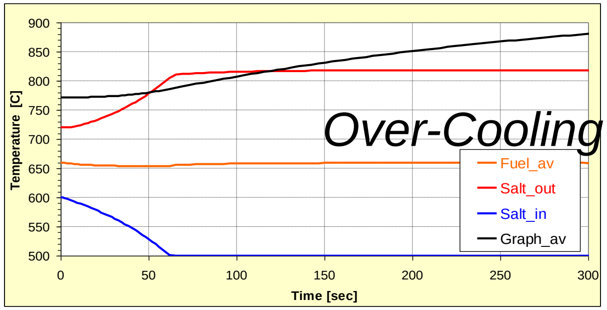
Safety calculations:SIM-ADS code (FZK)

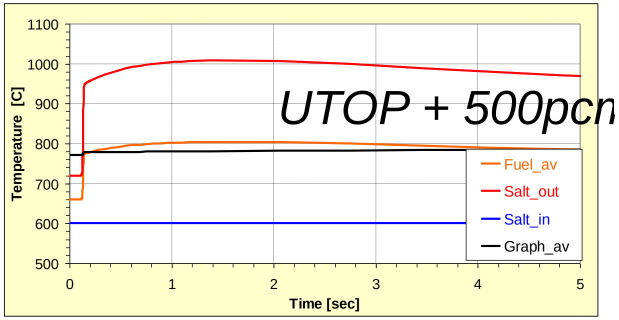
# MOSART Transients Analysis



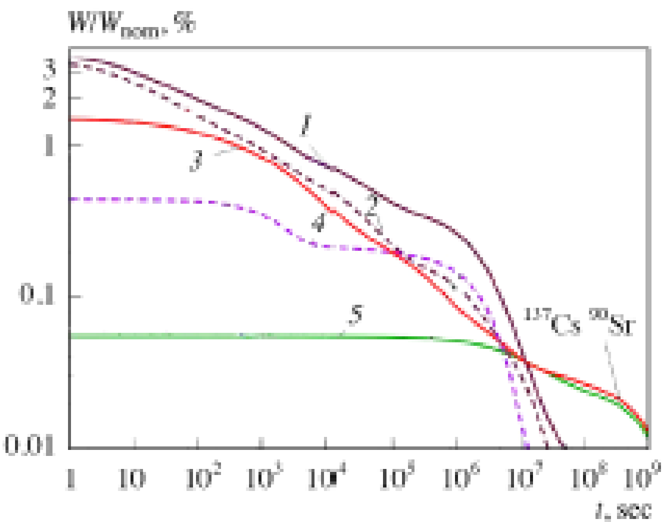




Doppler reactivity coefficient
$-1.6\cdot10^{-5}$ 1/°C
reflector
$-0.05\cdot10^{-5}$ 1/°C
Temperature reactivity coefficients are strongly negative (– 4.0 pcm/K ).

*MOSART is expected not to be seriously challenged by the major, unprotected transients such as ULOF, ULOH, overcooling, or even UTOP. The system was shown to buffer reactivity insertion of up to + 1.5$. System temperatures are expected to rise only ~300°C above nominal under this severe transient conditions. The mechanical and structural integrity of the system is not expected to be impaired.*

# Distribution of the Decay Heat




1) fuel salt
2) 4) FP’s and An’s in the fuel salt;
3) 5) Off- gas and fuel processing

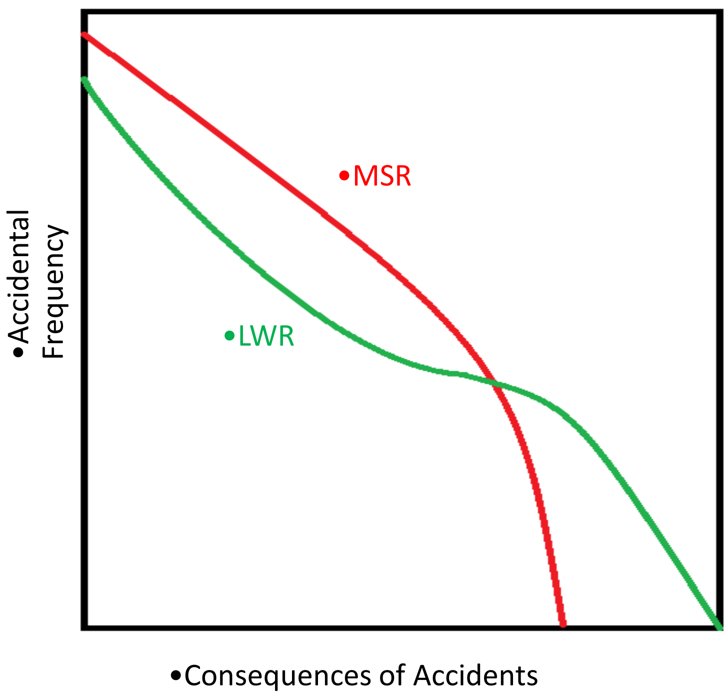
| Location of heat source *) φ -bubble sticking coefficient | Heat generation rate, MW | |
|---|---|---|
| | φ = 0.1 | φ = 1.0 |
| Fuel salt - all classes of radioactivity | 102 | 102 |
| Metal surfaces in primary system Noble metal deposits | 22 | 15 |
| Drain-tank system | | |
| Noble gases and daughters | 9.9 | 9.9 |
| Noble metals and daughters | 1.2 | 8.3 |
| Off-gas system: Noble gases + daughters | 2.4 | 2.4 |
| Fuel reprocessing plant: Fission products | 6.6 | 6.6 |
| Total | 152 | 152 |

# Severe Accident with the Rupture of the Main Fuel Salt Pipe and Fuel Discharged on the Reactor Cell Bottom

- The model based on mass transfer theory describing main radionuclides distribution between the fuel salt, metallic surfaces of the primary circuit, graphite and the gas purging system was applied for calculation releases to the containment atmosphere.
- As a criteria characterizing an isotope yield from the fuel salt is accepted the ratio of this isotope activity changed into a gas phase of a containment ($A_g$) to its full activity built up in a reactor by the moment of the accident ($A_0$)
- After accident considered all noble gases and metals available should move to the gas phase ($A_g / A_s = 1$, where $A_g / A_s$ -the ratio of isotope activity in the gas phase of the containment after an accident to its activity concentrated in the fuel salt by the moment of the accident). However, during the normal operation these nuclides are almost completely leave the fuel salt.
- For MSR the total release of radioactivity would be significantly lower (by I - 2 orders of magnitude compared to PWR), though for several particular nuclides such $I^{131}$ and $I^{133}$ the differences are smaller.

| Isotope | $A_s / A_o$ | $A_g / A_s$ | $A_g / A_o$ |
|---|---|---|---|
| Te129 | 0,25 | 1 | 0,25 |
| Te13 | 0,005 | 1 | 0,005 |
| Ru103 | 0,01 | 1 | 0,01 |
| Ru106 | 0,001 | 1 | 0,001 |
| Nb95 | 0,034 | 1 | 0,034 |
| Zr95 | 0,99 | 0,0011 | 0,0011 |
| Sr89 | 0,99 | 0,00046 | 0,00046 |
| Sr90 | 0,98 | 0,00046 | 0,00046 |
| La14 | 0,98 | 0,026 | 0,025 |
| Ce141 | 0,99 | 0,0024 | 0,023 |
| Ce144 | 0,96 | 0,0024 | 0,023 |
| I131 | 0,62 | 0,43 | 0,27 |
| I133 | 0,94 | 0,43 | 0,43 |
| Cs137 | 0,7 | 0,016 | 0,011 |

# Frequency distribution for the probability of accidents in the MSR and the LWR on the degree of contamination risk




- ✓ *The consequences of severe accidents in particular, leading to the release of radioactive products into the environment for MSR significantly less than for LWRs.*
- ✓ *Probability of an accident with a relatively low impact for MSR is higher than for LWR. This is due to the possibility of leakage of radioactive liquid fuel in case of accidents in the pump, piping, valves.*
- ✓ Developing reactor coolant system which will be reliable, maintainable, inspectable over the plant's lifetime is the key factor in demonstrating ultimate safety and licencebility

• Taube M., Fast and thermal molten salt reactors with improved inherent safety // TANS, 1981, Summer meeting, pp. 490-498

The construction of a large power MOSART is proposed to be preceded by the construction of 10 MWt Demo MOSART unit to demonstrate the control of the reactor and fuel salt management with its volatile and fission products with different TRU loadings for start up, transition to equilibrium, drain-out, shut down etc. There are opportunities to further improve the efficiency of burning minor actinides in MOSART, which will be justified by the results of the experimental setup.