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Meeting Paper

Concept for Isolating Nuclear Waste in Salt Formations

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Deposits of rock salt wide-spread on the territory of Russia and potentially suitable for disposal of nuclear waste (the number of which may be estimated as several scores) enable to establish in future the system of regional and centralized undergroundstorages. Among the greatest deposits of rock salt currently being operated we can emphasize the Novomoskovsk one (Tula town),the Svetloyar deposit Volgograd city), Yar-Bishkadak (Republic of Bashkiria), as well as deposits of Eastern Siberian saliferous basin having the area of over 680,000 sq.km (Zharkov, 1974). As an addition to a widerlist of well-known salt deposits one should mention Khatanga (Northern Siberia) saliferous basin (thickness of salt sediment is over 500 m, at the region of Nordvick, dept of occurrence equals to 140-300 m),Upper Pechora saliferous basin (thickness of salt deposit is over 300 m, depth of occurrence - from 200 m nd more), as well as salt formations near Kochmes (Inta) and in the north of Canin peninsula Dzhinoridze, 1995).

Given geological and mining conditions, as well as geographical position of the Khatanga saliferous basin (circling Taimyr peninsula from Nordvick till Norilsk) it may be considered as the major region for establishing a system of underground repositories for disposal (burial) of nuclear waste into salt formations.

To develop a detailed concept it is necessary to provide making up of the cadastre of salt formations on the territory of Russia) suitable for disposal of nuclear and radioactive spent-fuel waste.

One should pay attention to the following fairly known circumstance: provided that all necessary problems have been solved, starting from establishing regulations and legal basis and finishing with development of technique and transportation methods, the disposal of accumulated tonnage of nuclear waste may require not less than 10 years. For some regions establishing of regional underground storages in salt formations may take, at least, 2-3 years.

Given the current situation with nuclear waste depicted when evaluating the status of the problem (Section 1) in the Federal special programme "Treatment of nuclear waste and spent-fuel,their utilization and disposal for 1996-2005 years", the concept for disposal of nuclear waste in geological formations has to provide their safe isolation from the biosphere within short periods of time.

The main and principal distinction of the concept being developed at VNIIG Stock Co. is that storage and/or disposal of nuclear waste is planned both using native (geological) deposits of rock salt and creation of technogenic (artificial) salt formations.

Artificial salt formations are the composites of chemically solidified mineral salts which may be used for construction both subsurface repositories and underground storages in mine workings.

As a result of multiannual work a class of non-organic compounds was determined (over 50 units of phosphates, borates, silicates, sulphates, nitrates) enabling to employ their thermal, physico- chemical and physico-mechanical properties for quick and repeatedly reproducible isolation of nuclear waste.

Main advantages of constructing the repositories for nuclear waste in artificial salt formations are: possibility to isolate nuclear waste in different regions; long-term storage of nuclear waste nearby or directly in the areas of their generation; simplicity of the technique and reproducibility of properties of a filler in the matrix containing nuclear waste; possibility to remove nuclear waste from the matrix at a minimum cost.

One should also note the possibility to use the developed technique for making up artificial salt formations to isolate large size objects during their long-term storage, as well as to isolate nuclear waste located within housing areas in large cities.

In the proposed technique for creating artificial salt formations as a filler of matrices are used mineral salts having phase transitions (solid-liquid, liquid-solid) within the temperature interval from $30^{o}C$ to $250^{o}C$. Chemical compounds being used are heated till their melting temperature and poured into the matrix where are preliminarily situated nuclear waste (e. g., set in the central part). The composition of the material being used as a iller for the matrix is chosen so that melting temperature would be higher than the temperature of the heat source to be isolated. Under cooling the entire volume of the melt turns into a monolithic salt block. Preliminary investigations have shown that the use of technique for making artificial salt formations enables to considerably reduce materials' consumption. As compared to glass and concrete the radius of the shell (casing)containing a heat-releasing rod might be reduced about 2.4-4.7 times respectively.

A specified class of compounds capable to form crystallohydrates may be considered for the purpose of transforming liquid nuclear waste into the solid state in the form of artificial salt blocks.

Investigated mineral salts absorb, by weight, from 50 and more percent of liquid waste forming solid salt blocks.

As the matrix material (walls, bottoms and beam spans in a subsurface repository) we suggest to use the composites of chemically solidified natural raw materials, mineral binding agent and additives (forming hard-soluble salts) serving to decrease the rate of leaching radionuclides from a solidified monolith. Material of the matrix is prepared as a result of mechanical blending of the composite components (under normal temperature).

Peculiar features of the suggested hermetizing material for matrix manufacturing are:

- independence of hardening from temperature and environment;
- high strength of artificial stone at a rise of temperature;
- high rate of the composite hardening (3-8 hours) and final
- strength not under 400 kg/cm^2;
- sorption capacity of natural mineral raw material;
- accessibility of the composite components.

According to the developed process (technique) the subsurface repositories in the form of artificial salt formations may be constructed in any region or area of nuclear waste generation. With positive results of testing and pilot plant operation the implementing of the suggested technique will, al least, enable to mitigate the urgency of the problem to provide nuclear safety in some individual regions within a shortest time.