OVERVIEW OF SYMPOSIUM ON STORAGE OF SPENT FUEL FROM POWER REACTORS

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Abstract

An International Symposium on Storage of Spent Fuel from Power Reactors was held in Vienna from 9–13 November 1998. The Symposium was organized by the International Atomic Energy Agency in co-operation with the OECD Nuclear Energy Agency. Of the one hundred sixty participants registered, one hundred twenty five (including 3 observers) representing 35 countries and 4 international organizations, attended the Symposium. 20 participants from developing countries received Agency's grants. During 4 main Sessions, 44 oral presentations of papers were made and subsequent discussions held. At a poster session 13 papers were presented. This paper will give an overview of the Symposium. The Symposium gave an opportunity to exchange information on the state of art and prospects of spent fuel storage, to discuss the worldwide situation and the major factors influencing the national policies in this field and to identify the most important directions that national efforts and international co-operation in this area should take. It was obvious from the papers presented and the discussions that the handling and storage of spent fuel is continuously taking place safely. Dominant messages retrieved from the Symposium are that the primary spent fuel management solution for the next decades will be interim storage, the duration time of interim storage becomes longer than earlier anticipated and the storage facilities will have to be designed for receiving also spent fuel from advanced fuel cycle practices (i.e. high burnup and MOX spent fuel). It was noted that the handling and storage of spent fuel is a mature technology and meets the stringent safety requirements applicable in the different countries. The changes in nuclear policy and philosophy across the world, and practical considerations, have made interim storage a real necessity in the nuclear power industry.

1. INTRODUCTION

Continuous attention is being given by IAEA to the collection, analysis and exchange of information on spent fuel storage. Its role in this area is to provide a forum for exchanging information and to co-ordinate and encourage closer co-operation among Member States in certain research and development activities that are of common interest.

Symposia on this topic have been organised about once every four years since 1987. The purpose of the Symposium was to exchange information on the state of the art and prospects of spent fuel storage, to discuss the worldwide situation and the major factors influencing the national policies in this field and to identify the most important directions that national efforts and international co-operation in this area should take.

The Symposium consisted of several oral sessions and one poster session. The oral sessions addressed four major topics:

- National programmes;
- Technology;
- Experience and licensing;
- R&D and special aspects.

The sessions were chaired by Messrs. V.B. Ivanov (Russian Federation), F. Takáts (Hungary), W. Lake (USA), J. Vogt (Sweden), L.F. Durret (France), F.C. Sturz (USA) and M. Peehs (Germany). The detailed programme and list of presented papers and posters is given in Annex 1.

One hundred twenty five participants from 35 countries and 4 international organisations, who attended the presentations of papers and the poster session, reflected the worldwide interest in these important topics covered in this Symposium.

2. NATIONAL PROGRAMMES

It is noted that there continues to be worldwide growth in the generation of electric power using nuclear energy as its source. It is further noted that the rate of growth of nuclear energy generation has essentially levelled in Europe and North America while it has increased significantly in Asia. Although these trends have some impact on spent fuel management, including storage, the worldwide spent fuel production rate continues at about 10 800 t HM/yr.

About 130 000 tHM spent nuclear fuel was stored around the world at 1 January 1998 (Table I). Over 70% (93 100 tHM) of this amount is stored in at-reactor pools in 32 countries, while the rest is in away-from-reactor (AFR) facilities, either wet or dry. Presentations from 20 countries in the session on national programmes, and additional papers in the other sessions, covered 23 countries describing the technologies used to store more than 88% of the world total spent fuel to be stored.

TABLE I. STATUS OF SPENT FUEL STORED AT YEAR-END 1997

[kt HM]

	AR	**AFR**		**Total**
Regions		Wet	Dry	
West Europe	13.9	19.3	1.0	34.2
Asia & Africa	11.6	0.2	0.7	12.5
East Europe	7.8	9.9	0.3	18.0
North & South America	59.8	1.5	3.3	64.6
World	93.1	30.9	5.3	129.3

There are three major categories for classifying spent fuel management policies and practices. These include a closed fuel cycle which involves reprocessing of spent nuclear fuel, a once-through fuel cycle which, of course, ends with disposal of the spent nuclear fuel, and a "wait and see" approach.

There are several countries that continue strong and extensive reprocessing programmes. These countries not only reprocess their own spent fuel, but also provide reprocessing services to other countries. New reprocessing programmes are being developed in Asia. The once-through cycle leads to disposal of spent fuel. In some cases, direct disposal is being pursued, while other countries are committed to a planned storage period preceding disposal.

One can view the decision to either reprocess or dispose as two ends of a spectrum. There is a wide range of options between these two ends which have been called the "wait and see" approach. The "wait and see" strategy should not be viewed as avoiding a decision. It is a choice that allows for developing technologies to mature, it can accommodate evolving national policies, and provide the time to address public acceptance issues. Wait and see can be used where reversibility is desired.

There are several aspects of the "wait and see" approach that are not positive. Although wait and see could avoid financial risks associated with pursuit of technologies or approaches that do not meet their initial expectations, it could lead to missed opportunities, accelerated programme activities needed to "catch-up", and other cost increasing measures. Furthermore, one who chooses to wait and see could be perceived as indecisive, avoiding a difficult decision, or passing an issue on to future generations.

Wet storage remains dominant, even as the use of dry storage concepts increases. Wet storage is essential for cooling newly discharged fuel, and will continue to be the method of short term storage used in connection with reprocessing. The industry has an extensive experience base in wet storage with an excellent performance record.

Dry storage is being used increasingly as more long term storage of spent nuclear fuel is done. Dry storage may prove to be a cost effective activity. In addition, it can easily accommodate multipurpose systems (e.g., storage/transport, storage/transport/disposal).

Although at-reactor and on-site storage are common, many are considering the use of away from reactor storage concepts. There will always be storage at-reactors to allow for cooling. There could be increased at-reactor or on-site storage while interim and final spent fuel management solutions are being set. The centralized, away from reactor, storage options are expected to be more cost effective than the more dispersed, on-site storage approaches, which leads to the existence of many small storage facilities. Table II shows the status of the current spent fuel storage capacity.

TABLE II. STATUS OF SPENT FUEL STORAGE CAPACITY IN WORLD REGIONS

[kt HM]

	In operation				Under construction		
Regions	at NPP	Wet	Dry	Total	Wet	Dry	Total
West Europe	26.1	31.7	9.2	67.0		0.8	0.8
Asia & Africa	20.0	1.9	0.7	22.6	0.7	0.8	1.5
East Europe	14.3	19.6	0.8	34.7	0.8*	1.6	2.4
North & South America	94.9	1.8	10.0	106.7		6.8	6.8
World	155.3	55.0	20.7	231.0	1.5	10.0	11.5

* by reracking AFR storage capacity

The national choices for spent fuel management and storage reported at the Symposium were numerous. Decisions were evidently based on thoughtful and complete considerations of national needs and conditions. Because the national needs and conditions tend to be unique there is not a universally "BEST" approach.

The choice of how spent fuel is managed should not affect safety, however, the effort to achieve the required level of safety might differ. National regulations are applied to spent fuel management activities in a uniform way. The IAEA has an important role in assuring uniformity in National Regulations through development of its Safety Series Publications.

There were a number of common issues and needs that were raised during presentations and discussions. Public involvement and acceptance of spent fuel management activities was seen as an issue of increasing importance. Resource limitations are a common constraint on countries with smaller nuclear programmes. Because of the increases in communication and information exchange in the world today, events and actions by any one nation tend to affect the others. We need to all work together.

Two recommendations come to mind when the above issues and needs are considered. First, we must continue to exchange information, data and experience (from licensing to operations) on technical and public acceptance matters. Two, those who can, should consider providing financial and technical assistance to those with smaller nuclear programmes who are in need of such assistance. Any such support would be a wise investment in the future.

3. TECHNOLOGY

The presentations on dry storage largely focused on the specific needs of different utilities and organizations whilst ensuring compliance with the stringent safety requirements applicable in the different countries. It was generally recognised that casks are needed to provide for both storage and transportation requirements. This flexibility is of great importance to meet requirements with regard to design work, licensing procedures and manufacturing work. Furthermore, cask designs have to accommodate different fuel types, including MOX fuel, higher burnups and specific needs of individual power plants. Another example is early consolidation and encapsulation of spent fuel in disposal canisters in Germany. Current cask designs are based on proven and cost effective technology.

In the case of the vault storage systems, a concept, caters not only for the storage of spent fuel but also for the storage of a variety of other types of radioactive wastes. Also in this case the design is based on proven flexible and safe technology. In general, it appeared that there is a great consciousness of the need for optimisation and flexibility of storage designs in meeting requirements, within the constraints of the regulatory systems applicable in the different countries.

It was noted that, where reprocessing is not practised, dry storage designs have been developed. However, in the USA the concern of transportability is recently more important, as utilities are now expecting shipment of their fuels from reactor pools to a centralized storage facility. It was also mentioned that the transportability of the fuel is viewed favourably in terms of public acceptance. The dual purpose system already licensed or being licensed in the USA show that such solutions offer greater flexibility than storage only systems.

The situation is different in Europe where reprocessing and wet storage has been implemented by a majority of utilities. Therefore, transfer casks are largely available and AFR interim storage systems have been designed in using the transport containers as storage modules.

Utilities have reracked their reactor pools and increased fuel burnup in order to reduce the volumes of spent fuel to be managed. A concept of rod consolidation, which has been tested in the 1980s, could be of interest to manage larger quantities of spent fuel (in the same volume) on reactor sites. Also of interest was discussion of plans in the UK to store AGR fuel, in pools for up to 80 years.

4. EXPERIENCE AND LICENSING

In three sub-sessions, eight papers discussed regulatory and operational experiences with interim spent fuel storage. They described regulatory process and oversight, burnup credit analysis and measurements, and operational performance.

The first sub-session focused on regulatory aspects. One paper described the development of a regulatory process used to license modifications to existing facilities to increase capacities. Two other papers described regulatory oversight issues related to quality assurance (QA) and quality control (QC) associated with dry cask storage design, fabrication and operation. These papers discussed a variety of problems encountered, the corrective actions, and the regulatory actions taken to assure safety. These papers stressed the need for continued vigilance by cask designers, fabricators and users to assure reliable and safe interim storage.

In the second sub-session three papers discussed analysis and measurement techniques related to the use of burnup credit for criticality analysis. Several measurement techniques and methodologies for the characterisation of spent fuel assemblies have been developed. These techniques include passive and active neutronic methods as well as gamma-spectrometric methods, in order to:

- determine the fissile inventory for safeguards;
- verify the operator's declaration consistency;
- use burnup credit in storage, transport and disposal operations.

A method for applying burnup credit to the criticality safety design analysis for PWR pool storage reracking was presented. Of particular importance was the prediction and validation of the isotopic composition or depletion analysis through experimental results. At present, fresh fuel reactivity is used for spent fuel in criticality analyses. Burnup credit would offer an increased packing density in storage racks and therefore an increased capacity.

The two papers in the third sub-session discussed operating experiences with wet and dry storage. Both papers described evidence of better than expected performance. Dry cask storage testing performed in the United States was presented. Participants expressed continued interest about the importance of cladding performance, and in particular, future plans for testing to provide further evidence of fuel and cask integrity after many years in dry storage.

5. R&D AND SPECIAL ASPECTS

The information presented during the Session on "R&D and Special Aspects" can be grouped into 3 parts:

(a) Spent nuclear fuel (SNF) behaviour and properties;
(b) SNF treatment technologies;
(c) International co-operation aspects.

As a general observation it can be stated:

- no R&D was reported on wet storage. This underlines its position as a well established technology and all open questions related to wet storage have been satisfactorily answered;
- all contributions to the SNF dry storage discussed the storage performance of SNF for extended storage requirements such as increased fuel burnup, storage periods exceeding today's licensing limits or improved cladding material. The contributions demonstrate the continuing growth and acceptance of dry storage technology that has occurred over the past twenty years.

5.1. SNF behaviour and properties

Additional data on the creep of unirradiated Zr1%Nb to broaden the database had been reported. This material shows acceptable creep behaviour. The assessment of SNF dry storage performance with increased burnup concludes only circumferential creep in the temperature range > 300°C needs to be analysed. There are no other significant defect mechanisms in operation as SNF burnup increases above 50 GW·d/tHM. Results presented show that spent nuclear fuel dry storage is feasible for all spent fuel on the market — even with increased burnup. The assessment of dry storage of SNF for periods exceeding the presently licensed storage times resulted in an optimistic forecast. It is expected that dry stored SNF that has remained intact for 20 years will continue to perform for up to 100 years as storage conditions become less onerous. Data to support the assessment of SNF with increased burnup was reported at the symposium.

5.2. SNF treatment technologies

To date there has been little reported data on the decay heat of SNF after longer periods of storage. In the Swedish CLAB facility the decay heat of long stored SNF has been determined by calorimetry and gamma ray spectrometry and compared to calculated data. It was concluded that for SNF of longer storage periods the decay heat can be calculated if a detailed EOL data base describing the in-service operation is available. Furthermore, it could be shown that the decay heat can be satisfactorily determined by intensity measurements.

In two countries the final conditioning of SNF for disposal in geological formations is available. The Swedish experts had finalized their concept by demonstrating its technical feasibility. The technology will be developed in a pilot laboratory. In Germany the conditioning process is fully developed and the first installation on a technical-scale is nearly completely erected and will be commissioned in 1999.

5.3. International co-operation aspects

Countries with small nuclear programmes are candidates to join a regional spent fuel storage approach. This approach has already been applied for research reactor fuel with good success. Since time is ripe, also for commercial fuel, the IAEA started an initiative for interested countries.

Not just interim storage but a complete service including conditioning and also final disposal is suggested for an international approach. However detailed assessments are required in the areas of technology, economy, financing, institutional aspects, political aspects and ethic considerations. Until the outlined issues have been resolved the potential for such an approach cannot be judged positively.

6. CONCLUSIONS

There are three major categories for classifying spent fuel management policies and practices. These include a closed fuel cycle which involves reprocessing of spent nuclear fuel, a once-through fuel cycle which ends with the disposal of the spent nuclear fuel, and a "wait and see" approach. One can view the decision to either reprocess or dispose as two ends of a spectrum of options. It should be noted, however, that countries, which choose originally the reprocessing option, envisage the final disposal of high burnup and MOX spent fuel. The "wait and see" strategy should not be viewed as avoiding a decision, but as a means of evaluating the possible options and maintain the retrievability of the spent fuel.

Messages retrieved from the Symposium are that the primary option for spent fuel will be interim storage for the next decades, the duration of interim storage becomes longer than earlier anticipated and the storage facilities will have to be capable for receiving also spent fuel from advanced fuel cycle practices (i.e. high burnup and MOX spent fuel).

It was noted that the handling and storage of spent fuel is a mature technology and meets the stringent safety requirements applicable in the different countries. However, it is performed in a flexible and dynamic way, continuously adapting to changes in nuclear policy and progress in technology, for example transportability of spent fuel, application of burnup credit and utilisation of advanced fuel types.

Wet storage remains dominant, even as the use of dry storage concepts increases. Wet storage is essential for cooling newly discharged fuel, and will continue to be the method of storage used in connection with reprocessing. The industry has an extensive experience base in wet storage with an excellent performance record. Dry storage is being used increasingly, as more long term storage of spent nuclear fuel is done. Dry storage may prove to be a cost effective activity that can easily accommodate multipurpose systems (e.g., storage/transport, storage/transport/disposal).

Possible Agency initiatives could be described as:

- To assist in providing a technical reference for country reports to be delivered for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (i.e. establish common understanding of various technical issues of spent fuel management, in general, and spent fuel storage, in particular);
- To assist Central and East European Countries with problems related to the storage of spent fuel and establishing adequate spent fuel storage facilities;

- To assist in the evaluation and research of the long term behaviour of fuel and storage components in order to realise the anticipated long storage periods data;
- To continue the exchange of information, data and experience (from licensing to operations) on spent fuel storage technologies and public acceptance matters; and,
- To organise peer reviews in the subject of spent fuel storage and management.

Annex I

LIST OF PAPERS

OPENING SESSION

Spent fuel management overview: a global perspective (IAEA-SM-352/1)
__A. Bonne__, M.J. Crijns, P.H. Dyck, K. Fukuda, V. Mourogov

SESSION 1. NATIONAL PROGRAMMES

Spent nuclear fuel in Bulgaria (IAEA-SM-352/2)
__P.H. Peev__, N. Kalimanov
Spent fuel management in Canada (IAEA-SM-352/3)
A. Khan, P. Pattantyus, presented by __M.J. Crijns__
Czech interim spent fuel storage facility: operation experience, inspections and future plans (IAEA-SM-352/4)
__V. Fajman__, L. Barták, __K. Brzobohatý__, J. Coufal, S. Kuba
EDF's programme for spent fuel management (IAEA-SM-352/5)
A. Gloaguen
Licensing of spent fuel storage facilities in Germany; (IAEA-SM-352/6a)
F.H. Heimlich
Practical experience in spent fuel management for German NPPs (IAEA-SM-352/6b)
__A. Lührmann__, D. Althaus, R. Seepolt, K. Springer
Spent fuel dry storage in Hungary (IAEA-SM-352/7)
G. Buday, B. Szabó, __M. Ördögh,__ F. Takáts
Storage of spent fuel from power reactors in India: management and experience (IAEA-SM-352/8)
__R.D. Changrani__, D.D. Bajpai, S.S. Kodilkar
Spent fuel management strategy in Italy (IAEA-SM-352/9)
R. De Felice, L. Noviello, __I. Tripputi__
Spent fuel management in Japan (IAEA-SM-352/10)
__Y. Nomura__, F. Kunugita
The new technology of interim storage of failed spent fuel from the BN-350 (IAEA-SM-352/11)
V.N. Karaulov, __A.P. Blynskiy__, L.L. Yakovlev
Current status of spent fuel management in Korea (IAEA-SM-352/12)
__D.K. Min__, G.S. You, S.G. Ro, H.S. Park
The dry spent RBMK fuel cask storage site at the Ignalina NPP in Lithuania (IAEA-SM-352/13)
__V.V. Penkov__, R. Diersch
Status of the spent fuel dry storage programme for Cernavoda NPP (IAEA-SM-352/14)
M. Radu
Current state and perspectives of spent fuel storage in Russia (IAEA-SM-352/15)
V.A. Kurnosov, __N.S. Tikhonov,__ T.F. Makarchuk, Yu.V. Kozlov, V.V. Spichev, V.N. Bespalov, N.N. Davidenko, A.A. Reznik, A.N. Andrianov, V.A. Luppov
Status on spent fuel management in Spain (IAEA-SM-352/
__J.A. Gago__, J.M. Grávalos, P. Zuloaga
Radioactive waste management in Sweden: experiences and plans (IAEA-SM-352/17)
M. Wikström
Status of spent fuel storage facilities in Switzerland (IAEA-SM-352/18)
__P.C. Beyeler__, H.R. Lutz, __W. von Heesen__
The provision of safe storage of spent fuel from power reactors in Ukraine (IAEA-SM-352/19)
__Y.Y. Trehub__, Y. Pechera
The status of spent fuel storage in the UK (IAEA-SM-352/20)
__M.J. Dunn__, I.R. Topliss

Status and current spent fuel storage practices in the United States (IAEA-SM-352/21)
W.H. Lake

SESSION 2. TECHNOLOGIES
Dry Technologies, Wet Technologies

Influence of local regulations on TN dual purpose BWR cask (IAEA-SM-352/22)
P. Samson, *T. Neider*
Advanced techniques for storage and disposal of spent fuel from commercial nuclear power plants (IAEA-SM-352/23)
R. Weh, *W. Sowa*
Multipurpose SGN dry storage facility application to the Italian situation (IAEA-SM-352/24)
M. Giorgio, R. Lanza, presented by ***Ph. Michou, G. Locatelli***
Flexibility of the BNFL storage systems (IAEA-SM-352/25)
B. Dickson
Dual purpose or not? The significant factors (IAEA-SM-352/26)
W. Bak, ***V. Roland***
Onsite storage of spent fuel assemblies in German nuclear power plants (IAEA-SM-352/27)
J. Banck
The long-term storage of AGR fuel (IAEA-SM-352/28)
P.N. Standring

SESSION 3. EXPERIENCE & LICENSING
Licensing, Burnup Credit, Experience

Licensing of spent nuclear fuel dry storage in Russia (IAEA-SM-352/29)
A.I. Kislov, A.S. Kolesnikov
Experience with the licensing of the interim spent fuel storage .. facility modification (IAEA-SM-352/30)
S. Bezák, *J. Bére©*
Quality assurance and design control problems associated with the fabrication and use of spent fuel dry storage components (IAEA-SM-352/31)
T.J. Kobetz, T.O. Matula, S.F. Shankman, presented by ***M.W. Hodges***
Welding issues associated with design, fabrication and loading of spent fuel storage casks (IAEA-SM-352/32)
C.K. Battige, A.G. Howe, ***F.C. Sturz***
Characterization of spent fuel assemblies for storage facilities using non destructive assay (IAEA-SM-352/33)
A. Lebrun, *G. Bignan, H. Recroix, M. Huver*
Criticality analysis of PWR spent fuel storage facilities inside nuclear power plants (IAEA-SM-352/34)
J.C. Neuber
Radiometric characterisation supports, burnup credit, safeguards and radio-nuclide inventory determination for spent fuel transport, storage and disposal (IAEA-SM-352/35)
A.S. Chesterman, *M.J. Clapham, N. Gardner*
Experiences from the operation of the Swedish central interim storage facility for spent fuel, CLAB (IAEA-SM-352/36)
P.H. Grahn, *M. Wikström*
Spent nuclear fuel integrity during dry storage (IAEA-SM-352/37)
M.A. McKinnon, *L. Stewart*

SESSION 4. R&D AND SPECIAL ASPECTS
R&D, Special Aspects, Encapsulation

Creep properties of unirradiated Zr1Nb nuclear fuel cladding tubes under normal and abnormal dry storage conditions (IAEA-SM-352/38)
J. Veselý, M. Valach, Z. Frejtich, V. P⊆íman, presented by ***K. Klot□***

Assessment of dry storage performance of spent LWR fuel assemblies with increasing burnup (IAEA-SM-352/39)
M. Peehs*, F. Garzarolli, W. Goll*

Measurements of decay heat and gamma-ray intensity of spent LWR fuel assemblies (IAEA-SM-352/40)
J.I.A. Vogt*, L. Agrenius, P. Jansson, A. Bäcklin, A. HΔkansson, S. Jacobsson*

Extending dry storage of spent fuel for 100 years (IAEA-SM-352/41)
R.E. Einzinger, M.A. McKinnon, ***A.J. Machiels***

Regional spent fuel storage facility (IAEA-SM-352/42)
H.P. Dyck

Closing the gap between spent fuel storage and final disposal in a multinational management system (IAEA-SM-352/43)
P.J. Bredell

Conditioning of spent fuel for interim and final storage in the pilot conditioning plant (PKA) at Gorleben (IAEA-SM-352/44)
H.-O. Willax, ***H. Lahr****, H. Spilker*

The Swedish plans for encapsulation of spent nuclear fuel(IAEA-SM-352/45)
K. Gillin, ***J.I.A. Vogt***

CLOSING SESSION

Summary of the Symposium

POSTER PRESENTATIONS

Thermal design and testing of a dry spent fuel storage facility (IAEA-SM-352/1P)
D.G. Parkansky*, A. Garcia, S. Halpert*

WWER spent fuel criticality, depletion and shielding studies (IAEA-SM-352/3P)
T.G. Apostolov*, M.A. Manolova, T.M. Petrova, I.I. Popova, K.D. Ilieva, S.J. Belousov*

Study on increasing spent fuel storage capacity at JURAGUÁ NPP (IAEA-SM-352/4P)
R.J. Guerra*, D.L. Aldama, M.R. Gual, F.G. Yip*

Spent fuel temporary storage: Environ-mental impact assessment (IAEA-SM-352/5P)
T. □echák*, J. Kluso℥, V. Fajman*

Nuclear safety analyses of the dry spent RBMK fuel cask storage site at the Ignalina nuclear power plant in Lithuania (IAEA-SM-352/6P)
R. Diersch, H. Kühl, V.V. Penkov

Heat removal tests on dry storage facilities for nuclear spent fuels (IAEA-SM-352/7P)
M. Wataru*, T. Saegusa, T. Koga, K. Sakomoto, Y. Hattory*

Heat transfer study on dry vault storage system (IAEA-SM-352/8P)
H. Fujiwara*, T. Sakaya, T. Oka*

Burnup and cooling time determination of PWR spent fuel by measuring gamma-ray activity ratios of Cs-134/Cs-137 and Eu-154/Cs-137 (IAEA-SM-352/9P)
D.K. Min*, H.J. Park, K.W. Park, D.G. Park, S.G. Ro, H.S. Park*

Study for the selection of a supplementary spent fuel storage facility for .KANUPP (IAEA-SM-352/10P)
W. Ahmed*, J. Iqbal, M. Arshad*

International long-term interim storage for spent fuel; an independent storage service investor model (IAEA-SM-352/11P)
P. Leister

SCALE user's manual for VVER-related applications (IAEA-SM-352/12P)

L. Markova

Thermal-hydraulic analysis of VVER-440 spent fuel storage systems (IAEA-SM-352/13P)

Z. Hózer, *Gy. Gyenes*

Encapsulation of nuclear fuel residues from PIE and fuel testing at Studsvik for interim storage at CLAB in Sweden (IAEA-SM-352/14P)

A. Holmér

Investigation of the behaviour of WWER Spent Fuel Rods at Novovoronezh NPP (IAEA-SM-352/15P)

B.A. Zaliotnyc, Yu.B. Novikov, ***N.S. Tikhonov****, T.F. Makarchuk, I. Tokarenko, Yu.V. Kozlov, N.V. Razmashkin, H.P. Dyck, F. Takáts*