Paks Nuclear Power Plant Ltd.

Environmental Impact Assessment process for the lifetime extension of Paks NPP

Answers to the study of „Umweltbundesamt", to the statements of the provincial authorities of Lower-Austria, Burgenland and Wien, Greenpeace, Global 2000, the social organisations of Wien Platform called as "Future without nuclear energy" and to the opinion of Austrian private persons

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Introduction

The documentation identified as 0000K00ERA00046/A and titled as "Preliminary Environmental Study for lifetime extension of Paks Nuclear Power Plant" was completed in February and submitted to the Lower-Danubian Environmental Protection, Nature and Water Inspectorate (ADv KTVF) on 5 April 2004. The Inspectorate required supplying deficiencies for the documentation, which were completed by the plant. After approval the plant incorporated the answers given for the deficiencies into the above-mentioned documentation, and submitted the completed documentation in a uniform structure again to the Inspectorate identified as 0000K00ERA00046/C. This documentation was disclosed to the local municipality of the plant site (Paks) and other local municipalities concerned in the vicinity of the site. Also this documentation was given the Austrian ministry responsible for environmental protection, because Austria indicated its concern on 26 January 2005.

In connection with the documentation identified as 0000K00ERA00046/C the Austrian ministry responsible for environmental protection in Vienna sent comments on the Preliminary Environmental Impact Study as an attachment to the letter No. BMLFUW-UW.1.4.2/0074-V/1/2005 and dated on 23/09/2005 to the Impact Assessment Section of the International Environmental Policy Department of the Environmental Protection Ministry of Hungary, which consist of the following documents:

1. The study of „Umweltbundesamt", **„Report to the Austrian Government – EIA procedure for the lifetime extension of Paks NPP, Statement on the Preliminary Impact Assessment Study, September 2005"**.
2. Opinions of the principal authorities of Lower-Austria (in English language), Burgenland and Wien (in German language)
3. Opinions of social organisations (in German language: Greenpeace, Global 2000, Wien Platfrom called as "Future without nuclear energy"
4. Opinions of private persons (in German language) – 5 pcs.

Impact Assessment Section of the International Environmental Policy Department of the Environmental Protection Ministry of Hungary sent these documents to the Lower-Danubian Environmental Protection, Nature and Water Inspectorate. The Inspectorate forwarded these documents attached to its letter with filing number K5K9024/05 and reference number 100562-004-224/05, and their official translation attached to the letter with filing number K5K9332/05 and reference number 100562-004-229/05 to Paks NPP. In its letters the Inspectorate asked Paks NPP to assess and consider the opinions and comments of the Austrian party as appropriate during elaboration of the detailed impact assessment documentation.

The Paks NPP reviewed the documents received, considered the comments and suggestions included and classified them for response. It was concluded that according to the Austrian party the issues and technical suggestions to be clarified during the detailed environmental impact assessment do not belong to the scope of the Environmental Impact Study according to the Hungarian legal requirements, but to the nuclear safety licensing procedure of the operating lifetime extension.

According to the Hungarian effective laws the condition of operating lifetime extension of nuclear units, i.e. condition of their extended operation is to get a new operating licence. The expectations concerning the licensing procedure, the basic principle of licensing and its time limitation are specified by the point 2.4.2 of the Volume 1 of the Nuclear Safety Regulation

(NSR) that constitute the appendix of the Governmental Decree 89/2005. (V.5.). Accordingly, the current task of the plant is to establish the conditions for extended operation, to elaborate and implement the program for proving the plant's operability.

The program and documentation describing timely proportional completion of the specified tasks should be submitted by the plant to the nuclear regulatory body in 2008.

The nuclear safety licensing procedure belongs to the scope of the Hungarian Atomic Energy Authority. The Nuclear Safety Directorate of the Hungarian Atomic Energy Authority is authorized to proceed as an organisation of first instance.

In accordance with the section (5) of the paragraph 4 of the Act IV of 1957 on general rules of administration procedures, which was effective until 31. 10. 2005 and section (4) of the paragraph 19 of the Act CXL of 2004 on general rules of services, an authority should be deprived of a case belonging to its scope. Consequently, the nuclear safety issues belonging to the scope of the HAEA NSD should not be examined in the frame of the current environmental licensing procedure.

Nevertheless, it is important for Paks NPP to clear the doubts raised by the Austrian party and to give answers to the comments and statements. During the elaboration process of the detailed impact assessment documentation the comments of the Austrian party have been taken into consideration to the extent as it is required by the relevant regulations. In addition, the Paks NPP has also developed separate and more detailed answers on the basis of the technical documents and information that relate to the current operation and developed for the extended operation, involving the Hungarian professional organisations and considering documents and experiences of impact assessment procedures implemented in other countries.

The study of „Umweltbundesamt" served as the basis for the answers. It can be considered as a report developed for the Austrian Government relating to the Preliminary Environmental Impact Study for lifetime extension of Paks NPP, which also includes the most important statements and technical consideration. Of course, most of the comments given by the Austrian party (provincial, civil organisations and private persons) have been reviewed and answered, but due to repetition of some comments only references are given to the answers made to the study of „Umweltbundesamt".

Study of „Umweltbundesamt", **„Report to the Austrian Government – EIA procedure for the lifetime extension of Paks NPP, Statement on the Preliminary Impact Assessment Study, September 2005"**

Technical comments

The Preliminary Environmental Impact Study for operational lifetime extension of Paks NPP included all basic data concerning the planned activity, which were necessary to trace the changes expected due to the extended operation. In addition, the Preliminary Environmental Impact Study discussed the detailed environmental impacts, effects and processes, i.e. the basic issues of environmental impact assessment, water-environmental releases, thermal stress, changes of flora-fauna, water quality protection, air cleanness protection, waste treatment and disposal, social-economical issues, etc.

Both the main topics discussed in the section of technical comments of the study of „Umweltbundesamt" *and the expectations for elaboration of the detailed study focus on the tasks belonging to the scope of nuclear safety licensing.* In fact, none of the comments on the Preliminary Environmental Impact Study relates to the issues to be assessed in the frame of the environmental licensing procedure.

Most of the statements among the technical comments do not concern the activities of operating lifetime extension, they relate to current safety level of the plant. During the negotiations prior to EU accession a separate assessment report discussed and demonstrated safety level of Paks NPP. In addition, National Reports have been regularly prepared for assessing safety level of Paks NPP since the time of declaration of the Nuclear Safety Convention established by the International Atomic Energy Agency. Such comments on the National Reports have not been made and the given answers have been accepted by the Austrian party.

During the nuclear licensing process the HAEA NSD verifies whether all the nuclear safety requirements in the Volumes 3 and 4 of the Nuclear Safety Regulation (NSR) are met in accordance with the Final Safety Analysis Report elaborated on the basis of the Appendix 2 of the Volume 1 of NSR and the documentation supporting the operability beyond the planned operational lifetime elaborated on the basis of the Appendix 3 of the Volume 1 of NSR. If they are met, it is proven according to the point 2.002 of the Volume 3 of NSR that "protection of public individuals, groups and the environment" are ensured against the hazard of ionizing radiation.

All ageing and other nuclear safety issues should be discussed and managed in accordance with the requirements of NSR and by the HAEA NSD as a licensing authority during the nuclear safety licensing process for operating lifetime extension, rather than in the frame of environmental impact assessment. Under the scope of this procedure the Inspectorate ADv KTVF is involved as a professional authority, so the environmental protection inspectorate can enforce its further expectations after completion of the environmental protection licensing procedure, even during the nuclear safety licensing procedure.

At the end of this procedure having the nuclear safety licences the Paks NPP can implicitly prove that adequate level of safety can be maintained during the extended lifetime. It means that the Paks NPP can prove (even monitoring is required) that systems and components will not fail more frequently and will not cause initiating events due to ageing; performance of the

reactor vessel integrity, bubbler condenser tower and containment in general will function according to their the design basis; earthquakes will not occur more frequently and will not cause more severe consequences than before.

Consequently, in accordance with the effective Hungarian nuclear safety regulation the environmental protection licensing and impact assessment can relate to the issues that whether the conventional environmental releases will increase for the extended lifetime (observing the limits, of course), while radioactive releases will not increase for either the normal operation, incidents or accidents in comparison with the current values.

Study of „Umweltbundesamt", **„Report to the Austrian Government – EIA procedure for the lifetime extension of Paks NPP, Statement on the Preliminary Impact Assessment Study, September 2005"** Answers to the statements listed in the point 5.7:

The overall treatment of ageing in an NPP is of importance for the risk of extended plant operation. Of particular importance and safety significance is the ageing of the reactor pressure vessel, the steam generators and the confinement system.

The general statement of the study „Umweltbundesamt" concerning ageing is obvious, i.e. ageing occurs during the operation of nuclear power plants. Nuclear power plants can be operated until the end of their lifetime at a constant safety level since ageing is taken into account during design, construction, operation and maintenance. The lifetime extension beyond the design period requires careful consideration of the different ageing mechanisms and their synergic effects.

The Paks NPP has a wide range ageing management program, which includes monitoring of thermal and mechanical loads, periodical surveillance programs, technical-safety reviews and preventive maintenance.

In Hungary the licensing requirements for lifetime extension are specified by the Nuclear Safety Regulation (NSR) and associated guidelines as mentioned above. Prior to the owner's decision for operating lifetime extension a feasibility study was developed considering the international experiences and referred in several points of the Preliminary Environmental Study. Also, continuous technical support is provided by the so-called "advisory boards of experts", the members of which are delegated by the Hungarian scientific and technical support organisations.

Ageing management of the reactor pressure vessel (RPV)

Paks NPP made a lot of efforts to manage the reactor pressure vessel (RPV) ageing. The complete ageing management program of RPV is in accordance with the Hungarian Nuclear Safety Regulation of which are compatible with the international regulations. The safety of the ageing reactor vessel has been assessed according to the Russian PNAE code by the manufacturer (Skoda Works) and reassessed by the Hungarian TSO-s (technical support organization) in 1992-96. For licensing the lifetime extension the Hungarian Nuclear Safety Regulation requires a complete new safety and component ageing analysis. The HAEA NSD accepts the application of the ASME Code Section XI. to comply with this requirement. Under this analysis the following facts should be demonstrated:

- Paks NPP has the full manufacturer documentation of the RPV including the base materials and welding.

- Paks NPP has a surveillance program of which follows the thermal and irradiation ageing.
- Paks NPP and its TSO-s have a material ageing database.
- Each RPV of Paks NPP is periodically checked by non-destructive (ultrasonic) testing, which covers all relevant parts.

- A complete analysis of the operational and anticipated thermohydraulic events including PTS (pressurized thermal shock) was made by the RPV manufacturer Skoda Works. The analyses were repeated and confirmed by the TSO-s of Paks NPP. A complete new PTS analysis required by the Hungarian Code of Nuclear Safety in connection with the lifetime extension will be elaborated in accordance with ASME Code Section XI. These analyses include the update of the transient events lists, the thermohydraulic analysis of the selected transients, and the fracture mechanical evaluation of the safety until and beyond the extended lifetime.

Based on all existing analyses it can be stated that there is no obstacle to the operating lifetime extension of Paks NPP for further 20 years.

In case the calculations will not prove adequate safety until the end of and beyond the extended operating lifetime, Paks NPP will be ready to apply suitable technical applications (such as to increase the temperature of the emergency cooling water or to anneal the vessels) in order to maintain the expected level of safety.

The ageing analysis of the RPV-s of Paks NPP will be a part of the licence extension application. According to the Hungarian Nuclear Safety Regulation, the ageing management of the NPP components is an independent chapter of the lifetime extension application. In accordance with the international practice, the environmental impact study does not contain the details of ageing management, but only the currently available statements.

Ageing of Steam Generators

At Paks NPP the piping of the steam generators is made of stainless steel. Stress corrosion cracking problems emerged worldwide because steam generator pipes made of inconel and sometimes the corrosion of inconel led to the replacement of steam generators. The VVER-440 stainless steel steam generator piping is not sensitive for stress corrosion. The up-to-date Eddy current testing performed in every four years can locate the loss of wall thickness due to local corrosion. In case of severe reduction of the wall thickness, the damaged pipe must be sealed by plugging. Very severe criteria exist for the plugging and for the leaking of primary cooling water into the secondary circuit. They are in agreement with the international practice. At Paks NPP the condenser also separates the secondary circuit from the outside environment, and provides further safety against any release of radioactive water outside of the plant.

A VVER-440 reactor primary circuit includes six steam generators. According to the examinations performed so far and the results of secondary circuit chemistry, none of 24 steam generators of the plant should be replaced, considering also the extended operating lifetime of the plant.

Reliable data on the original state of the pressure vessel, the composition of the materials, the embrittlement surveillance program, the thermo-shock analyses performed etc. should be presented in the documentation.

The above statements give answers to the comments describing which requirements of the nuclear safety regulation are definitive in this issue, and how ageing treatment of reactor vessels and steam generators are performed. A short answer is given below to the statements in the point 5.2.1. of the report „Umweltbundesamt" for information purpose.

Original status and material composition of the reactor vessels

The reactor vessels of Paks NPP were manufactured by SKODA in its factory in Plzen. During manufacturing strict quality assurance and quality control systems were applied. Each different phase of manufacturing was controlled by the Hungarian experts on the site.

Data for the original "0" irradiation condition and chemical composition of the reactor vessel components around the core are recorded in the manufacturer's documentation of SKODA.

Description of the embrittlement surveillance program of the reactor vessel components around the core

In accordance with the recent international requirements each reactor of the Paks NPP has a set of specimens for monitoring radiation damage and ageing of the structural materials of each vessel.

In different countries surveillance programs applied for VVER-440/223 reactors vary to a lesser or greater extent. Hungary has the same set of specimens as of the surveillance program applied at Loviisa NPP.

Inside each reactor of Paks NPP six original sets of specimens were placed. Neutron flux affecting the specimens is almost 12-19 times larger than one affecting the inner surface of the reactor wall, i.e. the specimens taken out after 4 years represent damage corresponding to an operating lifetime of 48-76 years for the vessel. The specimens and their testing residue are stored in the way so that they can be identified when required.

The results of mechanical tests (the original measurement diagrams and data, microscopic photos, etc.) are stored in paper and digital format. Each set of tests is reported in a uniform format. The reports include the all original measurement results in numbers and the resulting conclusions. Contents and adequacy of the reports are reviewed and approved by advisory boards of experts.

PTS calculations

Whole-scope PTS (pressurized thermal shock) analyses will be implemented for the nuclear safety licensing of lifetime extension, which specify the nature and dates of required actions to be taken for the vessels for their 50-year operation.

PTS calculations will be performed in accordance with the Regulatory Body's Guide No. 3.17 (published by the HAEA NSD, connected to the requirements of NSR). The relevant

Regulatory Body's Guide was elaborated considering the program VERLIFE and recommendations of the IAEA.

The thermo-hydraulic transients constituting the basis of the PTS calculations have already been identified and modelled.

Description of the results of material and structure reviews

Deterioration processes of the reactor vessels can be inspected by the methods of destructive and non-destructive testing. Programs have been established on the basis of each testing method. With non-destructive testing the aim is to detect possible or already existing indications as a result of stresses, i.e. it is similar like a diagnostic method. The Technical Criteria Collection contains the testing methods and the Framework Programs include the locations and scope of tests. Non-destructive testing of the vessels of Paks NPP is performed by own and external testing organisations. Based on their results each ageing-sensitive component of the vessels is tested in a four-year period.

Also treated in some detail should be the corrosion of steam generators and the option of steam generator exchange; as well as the connection between steam generator corrosion and fuel element contamination.

The point 5.2.1. of the report „Umweltbundesamt" discusses the ageing of steam generators and evaluates the relevant statements of the Preliminary Environmental Impact Study. In the evaluation general statements are listed for similar problems of VVER plants, for the incident occurred in the Shaft No. 1 on the Unit 2 and about the issue of deposits. As stated above, we should repeat that the Paks NPP is now in the preparation phase of lifetime extension. Now, considering the conclusions of the feasibility study, the international experiences and requirements, the analyses - which will prove whether any modifications will be necessary or not - are being elaborated for nuclear safety licensing. However, the following brief assessment is given as an answer to the comments.

Evaluation of corrosion damage of the steam generators

The steam generators of the Paks NPP are one-body heat exchangers consisting of horizontally laid tubes with immersed heat exchanging surface, in-built condensing equipment, feedwater distributing system and steam header.

Heat exchanging surface of the steam generators include 5536 coiled pipes consisted of tubes of ∅16x1.4 and made of austenite stainless steel with material quality 08H18N10T. The ends of the coiled pipes are rolled in the primary header by explosive method along the whole wall thickness of the header. On their flanges they are arc welded with argon to the wall of the header.

The coiled pipes are placed in the steam-water space in a format like corridors to ensure natural circulation. The spaces between the coiled pipes are maintained by grids inside the tube bundles, which consist of flat strips and pressed corrugated sheets. The supporting strips and sheets are made of steel with material quality 08H18N10T.

The number of construction clearances in VVER-440 steam generators (in the vicinity of tube clamps) is 66432. The heat exchanging tubes are made of steel with material quality 08H18N10T.

The former feedwater distributors with material quality Ct20 have already been replaced in each steam generator. The new construction of feedwater distributors has changed the shell circulation of the steam generators, as a result of which erosion-corrosion processes have significantly decreased.
Between 1997 and 2000 the secondary chemistry was modified, as a consequence of which the measure of stress corrosion has significantly decreased. **Modification of the secondary circuit chemistry was a step towards operating lifetime extension.**

According to the analyses completed so far and having the statistics of steam generator plugging, we adhere to the statement that replacement of the steam generators of the Paks NPP should not be expected considering the current operating experiences.

The long-term behaviour of the confinement system (steel liner, barbotage system etc.) should be discussed in the documentation.

Ageing management and long-term behaviour of containments

The point 5.2.1. of the study „Umweltbundesamt" discusses the issue of ageing management of the confinement system. The structure and function of confinement systems of VVER-440/213 reactors are summarized, and the relevant information in the Preliminary Environmental Study is discussed and evaluated. It is stated that these issues should be discussed in more detailed during the detailed environmental impact assessment. The following brief summarizing answer is given to the statements in the Austrian study:

In case of a possible accident safety level of the Paks NPP is maintained and the environment is protected by safety and localization systems consisting of active and passive components. The passive protection functions are provided by the intended parts and structures of constructions. Beyond general structural stress – affecting industrial facilities – such structures were designed to meet the following requirements:

- Isolation,
- Protection against overpressure,
- Protection against inner splinters,
- Radiation protection.

The confinement part of the reactor building was designed for maximum pressure (0.25 MPa, absolute) occurring during LOCA (loss of coolant) incident after whole cross-sectional instantaneous break of the primary pipeline of 500 mm in diameter.

The construction is monitored and inspected during the operation on the basis of status control and maintenance (ageing management) programs. Types and extent of the experienced and expected ageing and deterioration processes corresponds to the international experiences.

The regular main reviews, implemented and planned repairs cover the following:

- Integrity tests annually performed in the containments.

- Possible deteriorating effect of ground water on concrete and behaviour of insulation are inspected by measurement of ground water level and analysis of water composition. (Ground water is not aggressive, so such kind of deteriorating process is not typical for the concrete structures at the plant.)
- Regular (every quarter) settlement measurements are taken on the constructions.
- During annual outages of the units the status of the coating of the confinements and bubble condenser towers, which can be decontaminated, are inspected, the required repairs are scheduled and performed.
- Regular inspection of steel sheet covers is performed by visual check and ultrasonic measurement of the sheet thickness.

Possible corrosion phenomena detected during inspections are eliminated and failures are repaired on the basis of detailed technological procedures that include proved and practically tested methods.

At each unit inspection holes are established on heavy concrete and normal concrete elements, where steel sheet covers and reinforced concrete structures are highly subjected to corrosion stress effects. No deterioration of reinforced concrete and concrete steel structures has been experienced so far.

In order to eliminate leakages detected during the operation so far adequate measures have been taken (repair of roof insulation, elimination of leakages, modification of water draining when technological systems are discharged, repair of dilatation elements, etc.).

In summary, in connection with the state of the containment and the main building, it can be stated that following the ageing management, status control and maintenance programs used at the plant the conditions of long-term and safe operation are ensured. On the basis of the reviews no nuclear safety-related deficiencies have been detected.

At the plant in the frame of the preparation procedure of the lifetime extension licensing the overall review of the ageing management programs relating to constructional components is now in process to prove that the current ageing management programs are suitable for maintaining the intended safety functions of the structural elements also during the extended operating lifetime.

Furthermore, the ageing of many other systems, structures and components can also be of safety significance. A comprehensive ageing management program is required and should be presented in the documentation.

Availability of the ageing management program should be demonstrated and it should be described during the nuclear safety licensing procedure by the plant, the requirements of which are specified by the point 2.4.2. of the Volume I of NSR.

Ageing management programs for the components of the plant

The lifetime of a plant is determined by the lifetime of the components that have important safety related or operational functions. They cannot be replaced or only at so great cost that is not reasonable and economical. It is obvious that until the end of the planned lifetime, even on

the last day of operation, all equipment and the whole plant should meet the safety requirements.

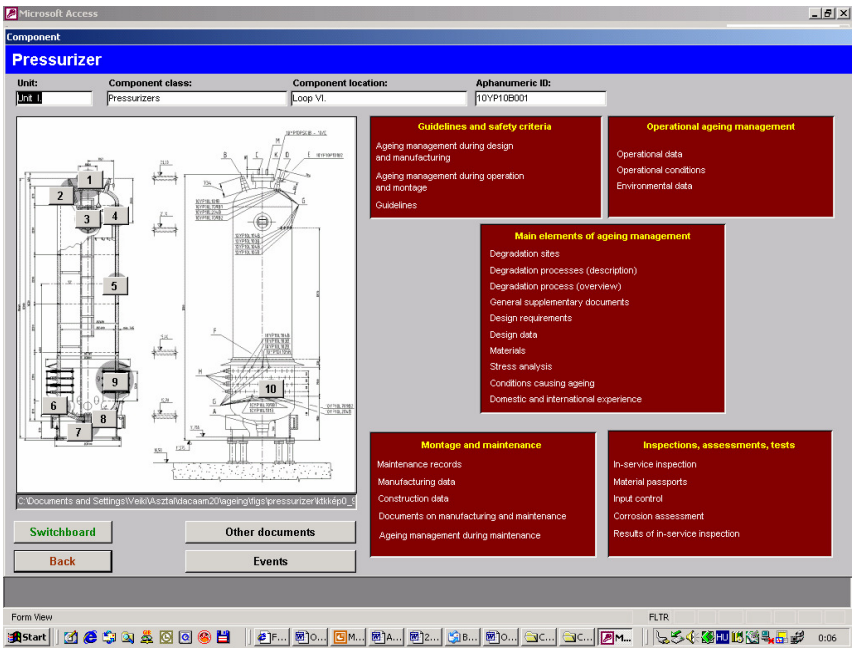
In 1993 the system of periodical renewal of operating licences was introduced in Hungary by Periodic Safety Reviews in accordance with the European nuclear safety regulation practice. During the reviews performed ten yearly it should be proved as a condition of the operating licence that despite the ageing processes the safety-related components are operable. This requirement is supported by the systematic ageing management activity introduced ten years ago and its extension for continuously increasing scope of components.

During Periodic Safety Reviews of the reactors the safety-related equipment, which are critical for the lifetime, have been identified. Ageing processes and critical components of the critical equipment have been detected in order to trace probable deteriorating processes and to determine required corrective actions.

The systematic ageing management system has been established and developed on the basis of the regulatory body's guidelines 1.26, 2.15, 3.13 and 4.12 and the recommendations of the IAEA AMP Guides supporting ageing management of nuclear power plants.

The important equipment of the systematic ageing management system has been identified in accordance with the current expectations of the regulatory body's guidelines updated last year.

The documents, information, analyses and deterioration process/critical component level testing results relating to ageing management of the important equipment are also available in a separate display system and database established for monitoring ageing management (DACAAM system). The DACAAM system was established according to the relevant IAEA AMP Guides and the Hungarian regulatory body's requirements for ageing management. The type of information and data relating to the system, their interrelations are indicated on the following diagram, on which the example of important equipment (pressurizer) illustrates the structure of the DACAAM system.



In addition to ageing management and ageing monitoring of the critical components the status of other structures, equipment and components are also controlled on each field at the plant ensuring the required technical level of the large number (but replaceable) of components in order to meet the safety requirements.

In the frame of the nuclear safety licensing procedure for lifetime extension the regulatory body requires reviewing the ageing management program of safety-related passive components. During the nuclear safety licensing procedure for lifetime extension the components, which perform their safety functions assumed in the final safety analysis report without having moving parts, changing their own properties or own location, should be identified as passive components. The review concerns more than 30000 mechanical components and covers all of the safety-related buildings and constructional structures.

The above-mentioned review is performed using the methods experienced in the licence renewal practice of USNRC, considering the following main steps of the ageing management program:

1. Identification of ageing processes and their effects.
2. Use of effective preventive measures.
3. Identification of the parameters to be reviewed.
4. Detection of ageing effects.
5. Monitoring of ageing processes, tracing of their trends.
6. Acceptance criteria.
7. Corrective actions.
8. Feedback (assessment of the effects of the actions taken).
9. Documentation and administrative control.
10. Evaluation of operating experiences.

The maintenance effectiveness monitoring system, which is currently being introduced for the safety classified components, ensures systematic monitoring of the adequacy of all activities (maintenance, material testing, status control programs, tests, etc.) maintaining the required performance level of the safety related functions. If required, this monitoring system ensures introduction of feedback and modification measures in timely manner. With adaptation of the "Maintenance rule" of USNRC 10 CFR50.65 to the Hungarian regulatory body's regulation the primary objective is to monitor ageing management of the large number of active components.

The effects on the safety margins of the plant related to ageing in connection with power uprating should be presented in the documentation, including the specifications and effects of the new type of fuel to be used.

Power uprating and lifetime extension

Section 4.3 of the report to the Austrian Government discusses the potential effects of the power uprating on lifetime extension. The report acknowledges that uprating of electric power by improving the efficiency of the secondary circuit has no effect on the safety and the lifetime of the units, i.e. the power increase from the original 440 MWe to the present 470 MWe value does not require any further comment.

It is the intention of Paks NPP to increase the power of the units to 500 MWe, basically by increasing the thermal power generated by the primary circuit from the original 1375 MWth to 1485 MWth. The report presumes that increasing the thermal output of the primary circuit the risk of operation increases and the ageing process is accelerated. These two presumptions are discussed below.

First of all it should be made clear that by law power uprating is a matter of HAEA licensing, based on modifications in the Final Safety Analysis Report and has nothing to do with Environmental Impact Study associated with lifetime extension. Moreover, power uprating will be licensed even if lifetime extension is not applied for. Since power uprating will precede the entire licensing process of lifetime extension, the lifetime extension process will be based on the plant parameters with increased power. Nevertheless it is probably not useless to provide information concerning the safety features of power uprating.

As far as safety issues are concerned, it is a clear intention of Paks NPP to maintain the same level of safety as before. This is also required by HAEA and this is a pre-requisite of licensing the power uprating. The underlying assumption of the Austrian report that a nuclear power plant and a safety authority would apply for or approve a power increase leading to the deterioration of safety is purely due to the anti-nuclear attitude of the authors and has nothing to do with reality.

The main limitation of the reactor power lies in certain properties of fuel elements. The traditionally used fuel elements are licensed for use in a primary circuit with 1375 MWth power. The two limiting operation conditions, namely the maximum fuel pin linear heat rate and the maximum subchannel outlet temperature are fulfilled for any core configuration. This is controlled by the core design calculations and the on-line core monitoring system VERONA. In the actual power increase project the two limiting operating conditions, which guarantee the safety of operation, remain unchanged. Moreover, the nominal cycle length also remains unchanged (325 effective days). Taking these essential factors into account, it can be deduced from almost trivial reactor physical considerations that the fuel economics will be worsened since more fresh fuel elements should be loaded into the reactor core than at present. Fuel assemblies of this type are in operation at Paks NPP and other VVER-440 units independent of the power increase, though these fuel elements are licensed for a primary circuit with 1485 MWth. This change of the lattice pitch is significant from the point of view of the power increase, since without it the two limiting operation conditions cannot be achieved at 1485 MWth.

Under these circumstances (unchanged flow rate, unchanged cycle length, unchanged limiting linear heat rate) enhanced corrosion of fuel surfaces may not occur.

Because of the above mentioned effects, burnup of the unloaded fuel assemblies will somewhat decrease. This leads to a certain decrease of the radioactivity in the primary water system, since this effect overcompensates the slight increase of the activity of corrosion products. The amount of radioactive materials potentially released during accidents also decreases. Similarly, the amount of radionuclides and the decay heat will not increase proportionally with the power increase.

Independent of the power uprating and its above consequences, another modification of the fuel assemblies is introduced, namely the application of a hafnium cover around the steel rod

connecting the absorber and fuel part of control assemblies, which has again a positive effect on safety.

Another important factor in the power uprating is the flow rate of the primary circuit. The higher the flow rate, the higher thermal power can be achieved. Nevertheless the increase of the flow rate may have negative effects, namely increased vibration and corrosion/erosion processes. This is why it is not intended to increase the flow rate of the units above the design value. Now the flow rate does not reach the design value on the Paks units. As a matter of fact the flow rate is below the design value at each unit of Paks NPP and it will remain unchanged for units 1, 3 and 4. In case of unit 2, where the flow rate is significantly lower than the design value, it will be increased by replacing the impellers of the main circulating pumps, but the flow rate will not exceed the design value.

In order to achieve the desired increase of power several modifications are also needed in the secondary circuit. As earlier, they have either no or only positive consequences concerning safety.

A further plant modification will be performed together with power increase. The initial hydroaccumulator pressure will be decreased from 58.8 to 35 bar, with a simultaneous increase of their inventory by 10 m^3. This modification (which has been already performed at the Loviisa and Dukovany NPPs) has a clear positive safety effect: the LOCA scenarios will be further smoothened and the chances for the primary feed under accidental conditions are increased. This modification alone has much larger safety consequences than the complex measures associated with the power increase.

The above qualitative considerations show that the power increase will be performed without decreasing the safety margins of the units. Nevertheless it is an obvious need to repeat the DBA analyses at increased power. These analyses have been completed and the results are already presented in the Final Safety Analysis Report. Thus the Accident Analysis chapter of the FSAR covers operation and accidents in the thermal power range between 1375 MWth and 1485 MWth.

HAEA issued the modification licence-in-principle of the power increase in November 2005. Nevertheless power will be increased gradually (introduced at different time at different units and at each unit the first increase will be only 2 or 4%), and the experience, gained at slightly increased power at the unit where it will be introduced first, will be evaluated and later on used in the subsequent steps of the project.

In the following section the second issue, the relationship between power uprating and lifetime extension will be discussed.

As it has been shown above, safety of the operation will not be deteriorated at all due to complex measures associated with the power uprating. Moreover, the complex measures of power uprating and those of lifetime extension represent a certain synergy, since the modifications in connection with power uprating will be implemented taking the needs of lifetime extension into consideration.

The only real problem which has to be accounted for is the increase of the neutron flux at the internal surface of the reactor pressure vessel, which is really proportional to the rate of the power increase. The application of a hafnium cover in the upper part of the control assemblies

decreases the inequalities factors inside the bundle, which enables to design lower leakage loading schemes as before. Consequently, the fluence at the vessel surface will decrease compared to the average value of the current core configurations. The calculations show that introducing the modified fuel and applying low leakage loading schemes in summary the power increase has positive impact on embrittlement of the vessel wall in comparison to the original status. Since all loads, rupture mechanical and other strength parameters will be analysed for the lifetime extension licensing process assuming 1485 MWth power of the primary circuit, there is no doubt that all the related special safety problems of the lifetime extension due to the power uprating will be considered during the licensing process.

The issue of seismic hazards (including both site seismicity and seismic design) will have to be presented and discussed in a comprehensive manner in order to permit the assessment to which extent appropriate, state-of-the art data and methods have been applied and which additional analyses might be required.

On the basis of the Preliminary Environmental Impact Study related to the lifetime extension of the Paks NPP Austrian experts expressed their opinion. They claimed that the issue of seismic hazards should be presented and discussed in a more comprehensive and detailed manner. They expressed two fundamental requirements:

- to demonstrate the degree of appropriate, state-of-the art data and methods what have been applied so far;
- and to evaluate the necessity of additional work of seismic hazard reassessment which may be needed in the future, and by when it will be completed.

Accordingly, we also split our comments into two chapters.

1. Activity on the assessment of seismic hazard until now

Planning and site selection of the Hungarian NPP were done on the level of science of the 60-70's and it was primarily based on a political decision.

The first remarkable seismic hazard assessment of the Paks NPP site was initiated at the beginning of the 1980's. The engineering-seismological report was released in 1987 by the Institute of Physics of the Earth, Academy of Sciences, USSR. They concluded that the probability of having intensity 6° in the site area is about 100 year, while 7° could be expected in every 10,000 year. In the second case, the corresponding maximum horizontal acceleration was 0.15 g.

The Hungarian scientific community however accepted neither the methods nor the results of the Soviet report, as they expected higher seismic hazard of the site. The first Hungarian Assessments were carried out in the years of 1989-90 and resulted in a seismic intensity of 7.8° and maximum horizontal surface acceleration of 0.19 to 0.28 g for 10^{-4} event/year probability on a 95% confidence level. This more conservative estimate received credit from new seismic profiling and complex interpretation of drill hole, gravity and magnetic data. These data showed young faults in the immediate vicinity of the NPP site with regional extent and strike concordant with the main tectonic lineament system of the Pannonian basin (ENE-WSW).

In 1991 the president of the National Atomic Energy Committee established a Scientific Coordinating Committee in order to elaborate and implement a coherent and purposive research project to reassess the seismic hazard of the Paks NPP site. The Committee summarized the results of the analyses in its report issued in February 1993 including the

horizontal surface acceleration value of 0,35 g as a conservative estimation for peak ground acceleration (PGA). The Committee left open the possibility of capable faults in the region for further investigation.

As a consequence, an independent international expert review was initiated by the Paks NPP. The Chairman of the National Atomic Energy Committee invited the International Atomic Energy Agency (IAEA) to coordinate the process of review.

In September 1993, IAEA experts finished the examination the methods and documents of the available site investigations. They came up with a conclusion that the input parameters taken into consideration during the planning of the NPP were indeed not in agreement with the level of seismicity of the site. At the same time they called the attention for the inadequacies of the site investigations, particularly, the need for application of internationally accepted regulations and methods were emphasized. Furthermore criticism was expressed on the completeness, control and quality assurance of the data. Therefore, the IAEA expert review concluded that the 0.35 g PGA estimated by the Scientific Coordinating Committee could not be taken as the basis of a seismic reinforcement program. Instead, the new reassessment should be fully compatible with the 50-SG-S1 (Rev 1) and 50-SG-D15 IAEA recommendations and the state-of-art probabilistic seismic hazard estimation should be applied. At the same time, further research was required to address the possibility of capable faulting and secondary seismic effects like liquefaction. For determination of the levels of design basis earthquake the recommendations of 50-SG-D15 of IAEA were suggested to be used. Accordingly, the maximum design basis earthquake (SL-2) should be defined with the frequency of 10^{-4} event/year according to the international practices.

In October 1993 the preliminary report about the IAEA expert review was discussed involving English, French and Italian experts and a research program was developed for finalizing the site investigation program. Accordingly, in the period of 1993-1995 three interlinked projects were carried out:

- design and implementation of a local seismic monitoring network, systematic data collection and analysis;
- new geological, geophysical and seismological investigations in order to check and complete the available data, particularly to acquire special high resolution seismic data both on land and the Danube river;
- geotechnical investigations to determine geodynamic properties and liquefaction potential.

The realization of the projects were coordinated by Ove Arup, UK and supported by an European Union project “PHARE Regional Programme for Nuclear Safety 4.2.1 VVER 440-213 Seismic Hazard Reevaluation”. The IAEA regularly reviewed, evaluated the realization of the projects and gave recommendations by its experts.

Ove Arup reported at the end of 1995 their final evaluation and a seismotectonic model as the basis for calculations. The maximum horizontal acceleration and corresponding response spectrum of the design basis (with the frequency of 10^{-4} event/year) earthquake were calculated. It was concluded that the value of the corresponding PGA was 0.25 g. It was also an important conclusion that global liquefaction is negligible at that probability level.

The Ove Arup’s final report was reviewed by IAEA and it was concluded that the report fulfils the IAEA recommendations and standards and the results are conservative enough for seismic safety evaluation of Paks NPP and can serve as a basis for the seismic reinforcement program. For the decision of the Hungarian Atomic Energy Authority a wide range seismic

reinforcement program was launched in 1998. As the results of the five year long program the Paks NPP has become one of the most earthquake resistant construction in the region. In addition, the IAEA recommended continuing the microseismic monitoring program because the current activity value of the known fault was not scientifically completed.

2. Planned activity on the assessment of seismic hazard in the future

According to the Hungarian regulation, every 10 year Periodic Safety Review (PSR) program is to be carried out in the Paks NPP. The next PSR is due in the period of 2006 to 2008, under the scope of which assessment of seismic hazard will be implemented independently of operational lifetime extension.

During the PSR program, the necessary additional data acquisition and field surveys will be carried out corresponding to the recent state of the art technology, a new seismotectonic model will be constructed and seismic hazard will be reevaluated by the most sophisticated methods. Preparation of the program already started in 2005 by an integrated analysis of the results of seismic monitoring network and construction of a 3D geologic-tectonic block model of the site area. The block model depicts the young fault system in the area and specifies its geometry. The monitoring results show that no earthquakes with a magnitude of M_L>1,0 has taken place in the 15 km radius of the NPP during the past 10 years.

In the frame of the new seismic hazard assessment all the input data received from the assessment made in 1995 will be reviewed. If it is required due to the recent state of the art technologies, new measurements will be taken and the seismotectonic model will be constructed by this improved data system.

According to the conservative safety philosophy seismic hazard will be calculated by probabilistic algorithm for different probable scenarios.

The issue of terror attacks and sabotage can and should be discussed without disclosing sensitive information.

According to the section 5.4 in the report of „Umweltbundesamt" the Preliminary Environmental Impact Assessment does not discuss the issue of terror attacks and sabotage, protection against them and their possible effects during their occurrence.

Of course, the Paks NPP considers and meets the physical protection legal requirements relating to the plant such a nuclear establishment. It is obvious that the physical protection of the plant cannot be described in detail, but in summary it can be stated that it is established and operated in accordance with the international convention declared by the statutory law No. 8 of 1987 relating to physical protection of nuclear materials and facilities, the document of IAEA INFCIRC/225/Rev.4 and the relevant Hungarian laws and regulations (Act on Atomic Energy and BM (Hungarian minister of the interior) decree 47/1997. (VIII. 26.) modified by the BM decree 45/2005. (X.18) BM). Maintenance of the technical systems, training of the staff involved in physical protection and required developments are continuously ensured in order to maintain the level of physical protection. There are several developments in process and planned to be implemented at the plant until the beginning of lifetime extension, which will further strengthen the protection against terror attacks.

The level of protection of Hungarian nuclear facilites and relevant activities – also of the Paks NPP – is assessed in complex manner in every second year under the leadership of HAEA in accordance with the decision made after the terror attack on 11 September 2001. The first such an assessment was implemented in 2002, then followed by the second one in 2004. During the assessments terror threats of the country, legal and preventive protection aspects of

the country-wide preparedness are reviewed. Threats, physical protection and preparedness of the disaster management organisations for preventing the consequences of terror attacks were assessed in detail and recommendations were made for taking actions.

The main statement of the last assessment implemented in 2004 was that in addition to the increase in general terror threats concerning the states of Europe there was no indication that the risk factors had been strengthening for nuclear facilities either world-widely or in Hungary. During preventive protection of Hungarian nuclear facilities there was no particular information referring to terror attacks experienced. The technical systems providing physical protection of the plant have been established, and they meet the relevant requirements, they are continuously maintained and technically developed. The operating and security guard staff is adequately qualified. The enforcement agencies involved in protection are in contact with both the plant and each other, the approved protection plans flexibly meet the actual situations.

Due to the high level of the above described physical protection and applied preventive protection the Paks NPP seems not to be an "attractive" target. Robust construction of the primary circuit of the plant and the fact that high activity materials are stored in highly protected areas from physical aspects disprove the occurrence of environmental radiological consequences described in the point 5.4. point of the study.

A comprehensive discussion of DBA and BDBA scenarios and severe accident management measures, including the results of safety analyses concerning BDBA (initiating events, scenarios, source terms) is required to assess the potential risk for the Austrian population in greater detail.

Consequences of large radioactive releases

The report to the Austrian Government basically accepts the results of radioactive release and dose calculations for Design Basis Accidents. As such events do not have significant consequences to the population even in the vicinity of the plant, one cannot assume transboundary effects.

As far as Beyond Design Basis and Severe Accidents are concerned, it should be made clear that according to the international practice the basic requirement is to reduce the probability of such events to an acceptable level. BDBA and SA releases are usually not limited in the international practice (the only exception in EU is Finland), but it is the duty of the national safety authority to judge whether the expected releases and the corresponding probabilities are acceptable. Obviously, the judgment of safety authorities is harmonized in Europe, but internationally accepted limits do not exist. (IAEA Safety Standards Series Safety Guide No. NS-G1.2.; UK NII Safety Assessment Principles 2005 Revision)

The report to the Austrian Government accepts that the probabilities for Paks NPP are as low as for any other nuclear plants in the vicinity of Austria or anywhere else. (It is worth mentioning that the probabilities cited in Section 5.5 are the probabilities of events beyond design basis, i.e. the probability of core melt is smaller than the cited values.)

Consequences of severe accidents can be obviously significant if the core melt leads to a large radioactive release. A Level 2 PSA study was carried out concerning Paks NPP between 2000 and 2004. It was pointed out that – similarly to other VVER-440/V-213 plants – the Paks

units have larger reserves (water, concrete, steel) against core melt than other reactor types. The containment study also showed that the real capacity of the containment is much higher than design value. The Level 2 PSA study was reviewed by various international expert teams.

Level 2 PSA led to acceptable results partly due to the preventive accident management measures introduced by the plant several years ago. The strategy of the accident management is to prevent core melt even in the case of beyond design basis accidents.

The developed conception classifies the actions to be made into two priority categories:

- The first priority activities should be implemented during the preparation and licensing procedure of operating lifetime extension, the pre-requisite of which is to plan the required technical modifications, to have them licensed and to start their implementation, to develop a set of emergency preparedness procedures (in some cases with missing or temporary elements) and to implement adequate organisational changes. The feature of this priority category is that the objectives should be implemented apart from the fact whether the lifetime of the units will be extended or not.

- The second priority activities include the technical modifications and other measures that will be introduced, if lifetime extension of the units will be approved, so the date of their implementation would coincide with the start time of the extended operation.

2. Opinions of the principal authorities of Lower-Austria (in English language), Burgenland and Wien (in German language) (Reference number: MA 22-2267/05)

According to the summary of the main critical points there is a lack of information about the ageing processes in the Preliminary Environmental Study, it criticizes the lack of emergency analyses and accident scenarios, and raises the interpretation problems of the German translation.

In several issues the detailed comments given to some points partially repeated the technical comments (section B) of the study „Umweltbundesamt".

Section A): The content structure of the Preliminary Environmental Study is described.

B) The analyses concerning ageing management do not belong to the scope of the environmental licensing procedure. The detailed answers are given among the answers made to the statements of the study of „Umweltbundesamt".

C) The question about power uprating cannot be understood (due to wrong terms or incorrect translation), but as we indicated in our answers given to the study of „Umweltbundesamt", power uprating belongs to the scope of the nuclear safety licensing procedure. The Environmental Impact Study detailed the technical steps of power uprating to the required extent. Accordingly, it is clear that the steam generators are not needed to be replaced for the implementation.

D) The questions about the reactor performance, design criteria, utilization factor and number of reactor shutdowns during the operating lifetime all belong to the scope of the nuclear safety licensing, they are not relevant to the environmental impact assessment.

E) The questions, which relate to the safety improvement measures of the reactors and by which method and at which intervals the systems are inspected, do not belong to the scope of the current procedure. The plant is operated according to specified nuclear safety requirements and licences, the Technical Operational Specifications and other plant procedures and instructions, their compliance, performance and review are also controlled.

F) The statement for retaining capacity of the pressure vessels belongs also to the scope of the nuclear safety licensing procedure.

G) To the statement about ageing the answer given above to the study of „Umweltbundesamt" refers.

H) The technical description of the steam depressurizing system (bubble condenser tower, bubble condenser, etc.) does not belong to the scope of the current procedure. Since the plant has a Technical Design and Final Safety Analysis Report for all systems, their conditions and structures are known for the licensing and reviewing authorities. There is no requirement for attaching such detailed documents during the environmental licensing procedure.

I) For the case of a quick turbine trip the plant has suitable action plans that are known also by the nuclear regulatory body.

J) To the issue of incidents the answers given to the statements of the study of „Umweltbundesamt" refer.

K) To the issue of terror attacks the answers given to the statements of the study of „Umweltbundesamt" refer.

L) Hungary has a Country-wide Emergency Preparedness Action Plan that details the actions to be taken in different situations.

M) Since the results of the assessments implemented for the Preliminary Environmental Study and for the Environmental Impact Study performed in the second stage definitely confirm that any transboundary effect due to the lifetime extension should not be assumed, it is not supported and proved to implement the required analyses.

3. Opinions of social organisations (in German language: Greenpeace, Global 2000, Wien Platfrom called as "Future without nuclear energy"

The comments given by these organisations are managed together because their statements are almost the same. Where there is a difference, the answers to Greenpeace are indicated differently.

Statements in the section 1: The statement does not refer to the specific document, but it contains general comments about use of nuclear energy and its problems, discussion of which is not the subject of the environmental impact assessment.

Statements in the sections 2-3: According to the Hungarian regulations during the environmental impact assessment a licensee (i.e. the Paks NPP) should assess the environmental impact expected of the extended operation of an operating plant, demonstrate the technologies to be used and whether what can be expected, if the lifetime extension fails, which means, of course, an alternative "0" in this case. It means that the task is not to prove the necessity of lifetime extension.
To the specific declarations, such as "… the necessity of lifetime extension cannot be proved in the study …", or "… the use of renewable energy sources in the Hungarian power supply is not detailed enough in the study …", partially we gave answers above, and we should note that these issues have been discussed to the extent as the regulations require. There is no requirement to demonstrate the Hungarian energy policy conception and decisions to be made about energy effectiveness measures in the environmental impact assessment study for lifetime extension of the Paks NPP. We should note that there is no another alternative for the Paks NPP because it has a licence for operation of nuclear units.

Statements in the section 4: The first paragraph of this section cannot be interpreted due to unprofessional wording and declarative sentences, the source of the referred IAEA data is missing. However, we indicate that IAEA support is ensured in this process because the progress is controlled in the frame of a joint project.
In Hungary the licensing procedure of lifetime extension is regulated by legal requirements (as mentioned above) including the Nuclear Safety Regulation and the associated guidelines.

Prior to the owner's decision for operational lifetime extension a feasibility study was developed considering the international experiences and referred in several points of the Preliminary Environmental Study. Also, continuous technical support is provided by the so-called "advisory boards of experts", the members of which are delegated by the Hungarian scientific and technical support organisations.

The statement No. 3 of the Greenpeace and the same one of the Global 2000 do not relate to the study because energy management of Hungary does not belong to the scope of the study. The statement No. 4 of the Greenpeace and the same one of the Global 2000 are equal to the content of the section 3 of the Platform, so the answer described above is relevant.

Statements in the sections 5-6: These statements refer to the assessment of external impacts on the units and the whole plant. According to the Hungarian regulations such assessments belong to the authority of the nuclear safety regulatory body, they are performed and managed independently of the lifetime extension. Such assessments are continuously updated in the frame of the Final Safety Analysis Report and the Periodic Safety Reviews. The last statement in the point 5.7. of the report made for the Austrian Government focuses also on this issue, so

the answer given to it refers also to the current statement. The same one refers to the statements about severe accidents.
The statement No. 5 of the Greenpeace and the same one of the Global 2000 are equal to the content of the section 4 of the Platform.

To the statement No. 6 of the Greenpeace the above mentioned answers are relevant.

The statement No. 7 of the Greenpeace relates to the issue of nuclear liability agreements, which is not the subject of the environmental impact assessment.

4. Opinions of private persons (in German language) 5 pcs.
Considering that the texts of five opinions from private persons are completely the same and their statements are essentially equivalent to the comments made by the social organisations, avoiding repetition we think that the above details will give answers to these statements.

Summary

In accordance with the effective Hungarian legal requirements the comments made by the Austrian party are not environmental issues but unambiguously nuclear safety related ones, and in Hungary - currently and even in the future - they are not assessed by the environmental authorities, but by the HAEA NSD.

Considering the technical comments and statements detailed in the present answering document, the comments given in the point 5.7 in the study of „Umweltbundesamt", the issues and statements raised by the Austrian social organisations and private persons were taken into consideration during elaboration of the environmental impact study for lifetime extension of the Paks NPP to the extent as it was appropriate for the details and depth of the documentation. In addition, according to the current information available in the present implementation phase of the lifetime extension and licensing process the current document gives answers to the questions and comments given in the point 5.7. in the study of „Umweltbundesamt", the issues and statements raised by provincial and social organisations, and private persons, which were forwarded by the Austrian party.