

# **SITE EVALUATION REPORT**

**On**

**UPDATED SITE REPORT for AKKUYU NUCLEAR POWER PLANT**

**ANS.GDR01E.USR**

December 2013

Revision 2

Department of Nuclear Safety  
Turkish Atomic Energy Authority

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## SITE EVALUATION REPORT

on

### UPDATED SITE REPORT for AKKUYU NUCLEAR POWER PLANT

<b>INSTALLATION</b>	
Name	Akkuyu Nuclear Power Plant
Code	ANS
<b>REPORT</b>	
No	ANS.GDR01E.USR
Date	06/12/2013
<b>LIST OF DOCUMENTS REVIEWED:</b>	
Basic Report for Akkuyu NPP Site	
(Signed by relevant personnel)	
<b>Prepared by</b>	<b>Reviewed by</b>
	<b>Approved by</b>

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## **Executive Summary**

The Akkuyu Site License, issued in 1976 to Turkish Electricity Authority, has been transferred to Akkuyu Project Company according to the Intergovernmental Agreement signed between the governments of Russian Federation and Republic of Turkey on building and operating four units of NPP in Akkuyu Site. The Site Report, which established a basis for the license, was composed of information gathered in 70's, and hence, it needed to be updated in accordance with the new regulations to include recent data and the new project information.

The requirement to update the Site Report has been stated in the License Conditions developed for Akkuyu site, which was notified to Akkuyu Project Company. The Akkuyu Project Company carried out new site investigations to update the necessary information. TAEK, to comply with the requirements laid out in the Decree on Licensing of Nuclear Installations, inspected these activities. The first version of the Updated Site Report had been submitted for review and assessment in May 2012.

During the drafting of Updated Site Report by Akkuyu Project Company, TAEK established the infrastructure for independent review of the Report, and procured consultancy from national expertise from universities to support review and assessment work to be done by TAEK. In this respect, after the submission, the Updated Site Report has been reviewed by the Advisory Committee on Nuclear Safety of TAEK to ensure that all relevant issues are addressed, and by an international team of IAEA to ensure the compliance with the IAEA Safety requirements and guidelines. Meanwhile, a team of TAEK experts also performed a thorough review and assessment of the Updated Site Report with the support of their national consultants.

The comments and recommendations made either by Advisory Committee on Nuclear Safety or IAEA review team, and findings of review and assessment activities performed by TAEK experts were communicated to the Akkuyu Project Company through Additional Information Requests and/or working group meetings between the TAEK and Akkuyu Project Company experts. It took time to overcome some generic problems arising from language barrier, such as ones arising from poor translation or misunderstanding of additional information requests made by TAEK experts.

The Updated Site Report, which falls short of demonstrating that the Akkuyu site has no characteristic that may cause rejection of site for building a nuclear power plant, was amended, updated and improved to the satisfaction of TAEK experts, and the new version of Updated Site Report had been submitted for approval in June 26, 2013. This version was also reviewed and assessed carefully and in detail to ensure that all issues are addressed properly to satisfy the regulatory requirements of TAEK, and requirements and guidelines of IAEA. This safety evaluation report is based on this review and assessment of GYR submitted in June 26, 2013.

Upon the review and assessment, Department of Nuclear Safety concluded that the final version of Updated Site Report sufficiently demonstrates the acceptability of site and that the site has no characteristic, which may cause the rejection of site.

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## **Abbreviations**

ACNS: Advisory Committee on Nuclear Safety

AIR: Additional Information Request

ANS: Akkuyu Nuclear Power Plant

APC: Akkuyu Project Company, namely Akkuyu NPP Electricity Generation J.L.C.

Decree: The Decree Pertaining to Licensing of Nuclear Installations

DNS: Department of Nuclear Safety

IAEA: International Atomic Energy Agency

IGA: Inter Governmental Agreement

Regulation: The Regulation on NPP Sites

SPR: Site Parameters Report

TAEK: Turkish Atomic Energy Authority

USR: Updated Site Report

VVER: Water Cooled Water Moderated Reactor

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## **Section 1. Introduction**

### **1.1. General**

Akkuyu Nuclear Power Plant (ANS) project has been started by an Inter-Governmental Agreement (IGA) signed between the governments of Republic of Turkey and the Russian Federation in order to build and operate a nuclear power plant in Akkuyu site. To implement the mandates of IGA, a project company (APC), namely, Akkuyu NPP Electricity Generation JSC has been established by the end of 2010.

According to IGA, four units of VVER 1200 (AES 2006 design) is to be built in Akkuyu site in Turkey. Akkuyu is a site within the Gülnar county of Mersin, located 140 km west of Mersin and 37 km south southeast of Gülnar. Closest settlement is the Büyükeceli town. Akkuyu site has been licensed in 1976 by the Atomic Energy Commission, the regulatory body by that time. The site license has been awarded to Turkish Electricity Authority, public electricity producer by 1970's, transferred to Electricity Production JSC upon reorganization, and allocated to APC by IGA. However, the Site Report [1], which establish a basis for the 1976 Akkuyu Site License, was out of date in terms of the project and some site characteristics, which can be remedied by updating the Site Report, accordingly. The Advisory Committee on Nuclear Safety of TAEK also recommended the update of Site Report as an outcome of a meeting held in May 13, 2011.

After the allocation of Site License to APC by Electricity Production JSC., who was the holder of the Site License of Akkuyu when the IGA was signed, APC applied to TAEK for approval of ownership of the site license and for determination of conditions for the use of Site License for Akkuyu Nuclear Power Plant Project initiated by the IGA.

In this respect, TAEK developed License Conditions [2] for Akkuyu Site License according to article 12 of the Decree [3], upon the application of APC on the utilization conditions of Site License. Among the license conditions, APC is required to update the site report for current project and characteristics of locale, in accordance with the current regulations.

Regarding the Akkuyu Site, various studies has been performed after the license issued until the APC has been established, by the licensee and other governmental bodies established upon reorganization of electrical production services of Turkey. Based on mandates of IGA, reports of all these studies have been provided to APC to determine the scope of update of site investigations.

APC has initiated the site studies as of March 2011 after notifying TAEK according to the Decree, and these activities are kept under regulatory control of TAEK through inspections and technical visits. According to provisions laid out in the Decree, the site report should clearly demonstrate that the site is acceptable for building and operating a nuclear installation, i.e. do not have any characters that would lead to rejection of the site. Content of Updated Site Report (USR) has been determined, accordingly, from the Guidelines on Format and Content of Site Report [4] and it has been communicated to APC through the working group studies, and through an official notification dated Jan. 19, 2012. Following the endorsement of the USR, APC will



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submit the Site Parameters Report (SPR) containing the results of detailed site investigations and exact values of site related design parameters, to the approval of TAEK as next stage of site licensing.

TAEK has adopted project management approach for all licensing activities of ANS. In this respect, a project team has been established within the Nuclear Safety Department to perform all regulatory activities related to ANS. The project team is composed of 50 experts from DNS, and groups has been established to handle work need to be done in specific areas. Procedures had been developed for all regulatory activities to ensure consistency among applications, including the inspections and the review and assessment.

The site activities have been managed by a group composed of 14 experts of DNS from various backgrounds relevant to site investigations. The site group also acted as members of working group on site activities established with APC, which meet monthly or more frequently as needed. The expectations of TAEK regarding the USR and other site investigations have been communicated through the WG meetings.

TAEK's activities have also been supported by outside expertise procured as consultants, and independent review by international experts through IAEA missions.

Within this context, APC has prepared the Updated Site Report including the recent site studies and submitted it for review and assessment of TAEK by May 22, 2012[5].

Upon first review and assessment of the USR by ACNS, IAEA experts and DNS project team, first set of Additional Information Requests (AIRs) were sent to APC [6]. Total of 17 AIRs has been raised to request further clarification on various issues. AIRs have been made as a result of the above-mentioned review and assessments and decided by the project team of DNS. Respond to TAEK's AIRs by APC were quite slower than expected, owing to the multiple translations and approval process of replies by Russian side. Even though it has been previously agreed upon that all technical communication is to be made in English and AIRs were given to APC in English, APC needed to translate them into Russian for the experts, and the replies were prepared in Russian and translated back to English. This process caused additional time loses in terms of review and assessment schedule of TAEK and problems due to translation errors.

Eventually, to minimize the time lost in review and assessment, TAEK adopted another approach, to discuss shortcomings in working group meetings. Even though this approach proved to have its own problems, TAEK continued to communicate the problems in USR in working group meetings to finalize the process in earliest time.

The second version of USR has been prepared by APC based on the findings of our team, and submitted for review and assessment on June 26, 2013[7]. This Site Evaluation Report, prepared by DNS summarizes the review and assessment performed by project team and introduces the findings of review and assessment performed on USR submitted on June 26, 2013.

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## 1.2. Basis for Review and Assessment

The licensing basis for the review and assessment process is to be prepared and approved by TAEK according to the Directive on Determination of Licensing Basis Regulations, Guides and Standards and Reference Plant for Nuclear Power Plants [8]. Since the licensing basis has not been established when the site investigations were started, the basis for site activities has been discussed and agreed on under the working group activities. Having relevant national regulations in place, the main regulatory documents that made the basis were the Decree on Licensing of Nuclear Installations [3], Regulations on NPP Sites [9], and IAEA safety requirement NS-R-3 Site Evaluation for Nuclear Installations [10].

The main regulation on site related activities is the Decree [3], which regulates main acceptance criteria for site report and relevant procedures. According to the article 9, para. 1 of the Decree;

*“The applicant has to submit a site report comprising the following information to obtain a site license from the Authority:*

- 1. Information regarding the utilization of the nuclear reactor facility to be build, its approximate power and among which reactor types it will be selected.*
- 2. Information regarding the technical capability, know-how and experience of the applicant and institutions carrying out site studies on behalf of the applicant,*
- 3. Regional map clearly indicating geography of the selected site and other detailed maps giving characteristics of surrounding area of reactor,*
- 4. Information and studies regarding topographical, geological, geotechnical, hydrological, seismological and meteorological characteristics of selected site,*
- 5. Layout alternatives depending on the reactor types considered,*
- 6. Information about the evaluation of the site with respect to natural phenomena such as earthquakes, floods and storms, and also their secondary effects,*
- 7. Information about the evaluation of site with respect to human induced external events such as crashes, fires, explosions and failure of dams, etc.,*
- 8. Information regarding adequacy of water sources to be used for cooling water purposes,*
- 9. Preliminary studies of the radiation exposure of the public due to the liquid and gaseous radioactive effluents during normal, anticipated operational occurrences and accident conditions. (Dispersion patterns of radioactive effluents into the environment, present and prospective population distribution, public water supply from the regional water sources, regional milk and food consumption, and radioecology are to be taken into account for these studies).*
- 10. Information related to the connection possibilities to national electrical grid and reliability of off-site electrical power.*
- 11. Quality Assurance Program for detailed site investigations.*

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*12. Other additional information which may be requested in the light of developments and new practices in nuclear safety.”*

Article 9. para. 2 of the Decree also states that;

*“It is necessary that the site studies presented in the site report are to be carried out adequately and the environment shall not be adversely effected more than the acceptable limits even in case of the maximum credible severe accident. Also, it has to be shown that any site characteristic shall not technologically exclude the construction of a safe nuclear facility at the proposed site, and those site parameters significant to safety shall be within acceptable limits from the latest technological applications.”*

Additionally, the Decree mandates that the detailed site investigations need to be carried out by the applicant in order to determine exact values of site related design parameters, after the site license is received from TAEK. Site related design parameters need to be submitted to the approval of TAEK prior to Construction License application.

In this respect, the site license is given based on the rejection criteria, and site report should clearly demonstrate that the site does not have any characteristic that requires rejection. The content of Updated Site Report has been established based on this approach and review and assessment has been performed accordingly.

For the further details of the main criteria laid out in the Decree, the article 5 of the Regulation on Nuclear Power Plant Sites [9] states that;

*“(1) For a site area to be a nuclear power plant site the following issues shall be taken into account;*

- a. The effects of natural and human induced external events on the proposed site area.*
- b. Site and site area characteristics that could influence transport of radioactive material to the people and environment.*
- c. Population distribution and intensity, and other site area characteristics, which may affect implementation of emergency measures.*

*(2) If the deficiencies identified in site area evaluation stage regarding these three issues, cannot be compensated for by means of design features, protection measures or administrative procedures the site shall be deemed unsuitable.”*

The USR has been reviewed and assessed for determining whether the necessary information stated in article 9, para. 1 of the Decree is included in, and whether the suitability of site is demonstrated adequately with respect to article 9, para. 2 of the Decree and article 5 of the regulation. During the detailed review and assessment, other relevant articles of the regulation, the Guidelines on Format and Content of Site Report [4] and Guidelines on Specific Design Principles [11] were considered in demonstration of adequacy of site.

The IAEA safety requirements NS-R-3 on Site Evaluation for Nuclear Installation [10], which has provisions regarding both siting and detailed site investigation process, was also among the licensing basis documents. Since the Regulation on NPP Sites is in complete compliance with IAEA

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safety requirements, conformance to IAEA requirements would inherently be assessed during in-house review and assessment of TAEK. Additionally, IAEA experts performed an independent review and assessment of USR to determine compliance with the NS-R-3, and reported their findings to TAEK.

The actual standards used in site activities are reviewed by TAEK for acceptability, as mandated by the Decree and the Directive [8].

### **1.3. Objective and Scope of Site Evaluation Report**

The Decree on Licensing of Nuclear Installation regulates site licensing stage in two stages. The first stage is the site license stage to determine the suitability of site for a nuclear installation. Site characteristics that may lead to rejection of site are investigated through preliminary surveys on site. The results of these surveys are reported to TAEK with Site Report for site license.

On second stage, detailed site investigations need to be carried out for determine exact values of site related design parameters. The results of these studies and the exact values of site related design parameters are to be presented to TAEK in Site Parameter Report form for the approval.

In this respect, the USR is in the site report characteristic aiming the demonstration of acceptability of site. The format and content of the USR has been determined by Site Group of our project team based on the article 9 of the Decree [3] to include all required information and communicated to APC by Jan. 19, 2012. Detailed information beyond the purpose of site license were requested to be presented with the Site Parameters Report on second stage.

This Site Evaluation Report, on the other hand, presents the review and assessment process and findings, evaluation and conclusions of this process. For each chapter of USR, the expected scope of chapter was introduced. Then, the main findings of review and assessment, means of addressing to these issues, outcomes of discussions and solutions developed were given, as applicable. The conclusion reached for each chapter of USR by the TAEK review team was also given.

Overall conclusion of the process was based on review and assessment of amended and improved USR submitted in June 2013 [7].

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## **Section 2. Inspection and Technical Visits of Site Activities for USR**

The site activities regarding preparation of USR were monitored and inspected by the Site Group of the project team. APC's plan of site activities has been used for determining the amount and time of TAEK's inspections and witness points. The purpose of inspection activities were to oversee the activities on site, to ensure that these activities are carried out under a quality management program and to ensure that the activities performed on site are in compliance with the safety and quality requirements laid out in licensing basis. TAEK also performed technical visits to site to observe the activities.

### **2.1. Technical Visit to Akkuyu**

Upon notification of TAEK on initiation of site activities, TAEK organized a technical visit to site to familiarize itself with the site, site personnel of APC and to monitor the activities recently started on June 9, 2011. There were 4 experts from site group and an outside expert who was Akkuyu Site Manager of previous license holder.

Main purpose of this technical visit was to determine the current situation of Akkuyu site. The findings of the technical visit has been recorded in a mission report [12]. Main finding of the technical visit that needed special attention was lack of notification of TAEK about the guides and standards used in site activities. As a result, the APC has been warned for making this notification in advance of commencement of activities on site.

### **2.2. First Site Inspection**

Based on the APC's plan of site studies, first inspection has been performed on Sept. 8-9, 2011. The scope of inspection covered the meteorology, quality management, hydrology, geology, geophysics, hydrogeology and geotechnical studies carried out on site. Inspection team was consist of four TAEK experts. An inspection report has been filed on findings [13].

Main findings of this inspection were insufficient resolution of a meteorological monitoring device, called SODAR, and lack of quality documents of sub-contractor company ENVY. These main findings has been communicated to APC through an official letter, and requested corrective actions to be taken. Beside these main issues, recommendations has been made for minor issues within the same letter.

The response of APC to SODAR issue was to demonstrate that the stated resolution of the device given in relevant Russian regulatory guide [14] was only a recommendation. For the sake of having better estimation of atmospheric conditions, a newer SODAR system capable to reach up to 2500-5000 meters with 20 m resolution were preferred instead of SODAR reaching up to 500-1000 meters with 10 m resolution. The response of APC has been considered as acceptable, and the issue has been closed.

As for the second issue, TAEK performed an inspection to ENVY main office to verify the statement made at site about having quality management system with the documents filed in main office of the company.

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### **2.3. Inspection of ENVY Main Office, Subcontractor of APC**

The inspection of Main Office of ENVY, planned based on findings of first inspection, has been performed on Sept. 28, 2011. ENVY, the main subcontractor of the APC is a Turkish company. The quality management aspects of studies carried out by this company has been ensured through an audit performed in company main office. Three TAEK experts performed the audit on quality management documents of the company, and an inspection report has been filed on findings [15].

The company was able to produce quality documents for the inspection team, which were reviewed in situ. Only minor findings were made which were about the APC control on sub-contractors quality system and they are communicated to both APC and ENVY, officially.

### **2.4. Second Site Inspection**

The second inspection of the site activities has been implemented on Oct. 25-28, 2011. The scope of inspection covered the meteorology, hydrology, geology, hydrogeology, geotechnical, geophysical and quality management of studies carried out on site. Inspection team was consist of five TAEK experts. An inspection report has been filed on findings [16].

During this inspection, another subcontractor of APC, RIZZO was working on site. Their quality management system and activities were inspected. Main finding was about the regulation, which is used for technical activities on site. This regulation was not among the licensing basis for site activities mutually agreed upon by APC and TAEK. This finding and several other minor ones were communicated to APC officially.

### **2.5. Evaluation**

Site inspections are carried out according to an inspection plan to audit the compliance with the regulations, safety targets and license conditions. In this respect, corrective actions were requested for findings and non-compliances. TAEK also ensured by follow-up that these corrective actions were implemented. Upon the non-compliance filed based on findings of second inspection, the use of standards by RIZZO in site investigations which are not in licensing basis, the APC stated that the results of these studies will not be used in USR. During the review and assessment of USR, this issue has particularly been reviewed, and found out that the results of site investigations reported by RIZZO has not been referenced in USR. USR referenced Worley Parsons and ENVY studies on the same subject. USR referenced only analyses performed by RIZZO such as seismic catalog and seismotectonic modelling studies.

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### **Section 3. Review and Assessment Process Conducted**

According to Review and Assessment Guidelines of DNS, the review and assessment process was composed of two main stages. First, the completeness of the application is controlled. If application is accepted, review and assessment of submitted documents is started. As parallel independent processes, the Advisory Committee on Nuclear Safety reviews the submitted documents. Additional means of independent review and assessment can also be used by NSD.

Based on this generic guidelines, a specific guideline was developed for the review and assessment of Site Report [17]. The USR has been reviewed and assessed according to the flowchart (Annex I) of this guideline.

For the review of USR, it has been decided that the independent review of USR by international experts recruited through IAEA with respect to the IAEA safety requirements will be enough. The basis for this decision was the context of submitted material and the expertise held within the DNS. Services of national experts were procured to support the review and assessment activities of DNS.

Within the context of independent review, a review of USR by international experts under the coordination of IAEA to determine the compliance with the IAEA safety requirements and guides has been deemed sufficient. This decision has been reached based on the content of USR and level of expertise of project team.

Additionally, consultancy services from national universities has been provided for the review and assessment activities of site group of ANS licensing project team.

#### **3.1. Acceptance of Application**

USR that has been submitted according to mutually agreed upon content on May 22, 2012 has been reviewed on completeness control as the first step of review and assessment procedure. The USR had important shortcomings to TAEK's expectations, as the language and quality of the report being the main generic problems. The English version of originally Russian text contained considerable amount of translation mistakes, some of them resulting in important mishaps. However, it has been decided to initiate the review and assessment procedures on this report and resolve the generic problems emerged on completeness check. Since the translation errors reduced the understandability of the report, they considerably lengthen the review and assessment duration.

#### **3.2. Review and Assessment**

Upon acceptance of USR for review and assessment, the planned activities has been initiated within the project team according to the schedule. USR has been submitted to the review of Advisory Committee of Nuclear Safety (ACNS) according to the mandate of the Decree and to the independent review of international experts through IAEA on compliance with the

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IAEA requirements. Meanwhile, the review and assessment of USR within DNS has been promptly undertaken.

### ***3.2.1. ACNS review***

The USR has been provided to ACNS members of TAEK for review of and comment on the document as mandated by the Decree [3]. In June 2012, the first ACNS meeting was held regarding the introduction of USR and explaining expectations. After ACNS review has been completed, a joint meeting has been held with ACNS members and site group of project team on July 27, 2012.

ACNS has submitted their comments on the USR to TAEK as minutes of meeting on July 27<sup>th</sup> meeting [18]. ACNS, emphasizing the importance of USR, recommended remediation of translational errors, including poor referencing. The committee has given examples of such mistakes in their report and recommended that a thorough editorial effort should be given into the USR.

The ACNS has also noted that some studies were yet to be completed, as it was stated in USR, and found this in compliance with the approach explained under section 1.2, “Basis for Review and Assessment” of this report. However, ACNS recommended DNS to pay due attention to those studies in order to ensure completeness of the USR at the end of the process.

Additionally, ACNS pointed out the chapters of USR in which more information need to be provided at the given stage. “Seismic hazard analyses”, “Reliability of off-site electrical power” and “Long term atmospheric dispersion analyses” were the main areas in this respect. ACNS also listed some shortcomings of USR and recommended;

- a) Inclusion of AFAD (Disaster and Emergency Management Presidency) and MTA (General Directorate of Mineral Research and Exploration) databases in seismic studies,
- b) Justification of low release rates in case of a severe accident with respect to an example given in IAEA technical document [19], and
- c) Consideration of some additional meteorological events, such as tornados.

Finally, ACNS recommended DNS that some declarations of USR need to be confirmed at later stages of licensing.

All ACNS recommendations were taken into account during the review and assessment of DNS and preparation of Additional Information Requests (AIRs) made to the APC. In this respect, the ACNS recommendations are properly addressed in this report, and their comments were recorded for later stages to be addressed in due time.

### ***3.2.2. IAEA review***

In order to have an independent review, TAEK collaborated with IAEA to review the USR with respect to IAEA requirements and guidelines. The scope of the review has been preset as compliance with IAEA requirements and guides on NPP sites and to determine whether adequate site investigations are carried out to ensure that the site has no characteristics and features that could result in the unacceptability of the site.



The IAEA has established a team of international experts to work together with the experts from IAEA, as seen in Table 1. The USR has been provided to these experts in advance and their findings has been discussed with site group in a mission meeting held in Ankara on Aug. 13-16, 2012.

Table 1. The international expertise used in review and assessment of USR

Expert	Area of Expertise
Hamid Mahmood of IAEA	Human induced events, flooding, geotechnical
Alessandro Michetti of Italy	Geology, geophysics, hydrogeology
Akşit Tamer of Germany	Population distribution, meteorology and atmospheric dispersion

The review team agreed with the TAEK’s methodology of handling the site stage, and found having the detailed site investigations after the site license as an acceptable approach. The team has made total of 17 recommendations to satisfy the relevant IAEA requirements and guides [10, 19, 20, 21, 22, 23, 24, 25]. The distribution of these recommendations with respect to areas of review is given in Table 2.

The recommendations made by IAEA team has been documented [26] and reconsidered by TAEK experts. Since the Turkish regulatory system defined sub stages of site stage, the recommendations of IAEA experts were classified into stages of national system, some to be addressed at approval of USR and some to be addressed at later stage of site parameter approval.

Table 2. Recommendations on review areas

Review Area	# recommendation
Feasibility of implementation of emergency plans	4
Meteorology	6
External human induced events	3
Surface faulting	3
Geotechnical hazards	1

The recommendations particularly on feasibility of implementation of emergency plans were addressed during the approval of USR.

### ***3.2.3. DNS review***

The site group that reviewed the USR in TAEK is composed of 14 experts (Annex II) from different areas of expertise, from geology to biology, from environmental engineer to nuclear engineers. This group had the support of national experts whose consultancy services were procured for this specific purpose. The list of national experts were given in Table 3. Consultants worked together with site group throughout the review and assessment process and attended the working group meetings with the APC experts. Since the consultants provided their input by participating in the review and assessment process, they were not expected to provide separate reports, but their contributions are included in the preparation of review and assessment reports.

Table 3. The national expertise used in review and assessment of USR

Consultant	University	Area of Expertise used
Prof. Dr. Mehmet Ekmekçi	Hacettepe Univ.	Hydrogeology, Hydrology, dispersion of radioactive material
Prof. Dr. Nuretdin Kaymakçı	Middle East Technical Univ.	Geology, seismology
Prof. Dr. Selahattin İncecik	Istanbul Technical Univ.	Meteorology
Prof. Dr. Kemal Önder Çetin	Middle East Technical Univ.	Seismology, geotechnics

The site group has reviewed and assessed the USR submitted on May 22, 2012, based on the Decree, the Regulation on Nuclear Power Plant Sites, and the Guidelines on Format and Content of Site Report for NPPs. Besides the generic problems of translation, the main and secondary findings of site group on USR can be grouped into three as additional information needed to comply with the article 9 of the Decree [3], insufficiency of USR to serve for its purpose defined in the article 5 of the Regulation [9], and poor quality of the report. While typos constitutes for most of the secondary findings, findings on first two issues were considered as main.

The findings of first review and assessment, including the recommendations of IAEA and ACNS, have been submitted to APC in the form of Additional Information Requests (AIRs) [6]. A list of AIR subjects were given in Table 4. Even though APC provided responses to these AIRs, the information provided were far from being satisfactory. Additionally, answers to AIRs were another demonstration of grave translational errors made in the process. It appears that the AIRs prepared in English by TAEK has been translated to Russian for the Russian experts, and their answers in Russian were translated back to English. During these double translation, all details brought up by TAEK were lost in translation causing grave misunderstanding of AIRs by Russian experts, and their responses led to further confusions.

Since the answers to the AIRs provided by the APC were not satisfactory to clarify the issues at hand, the site group began discussing each issue separately within the working group established together with APC, further explaining the expectations of TAEK on each issue until it has been solved. Solutions of issues led to a need for major update in USR.

Upon further discussion of issues on working group meetings, justifications on some issues, listed in Appendix III, provided by APC stating that these issues do not contribute the demonstration of suitability of site, has been found adequate, and provision of detailed information on these issues at the site parameter approval stage has been accepted by TAEK.

Based on the working group studies on each issue, the USR has been brought up to the status that is acceptable with respect to licensing basis. APC has updated the USR and submitted the new revision of USR on June 26, 2013, which was reviewed and assessed again.

Table 4. Additional Information Requests

AIR #	Section	Issue
EBT.SL.GYR.001	9	Justification of Most Credible Accident
EBT.SL.GYR.002	5	Provision of references and referencing mistakes
EBT.SL.GYR.003	5	Comparison of methods used in Tsunami
EBT.SL.GYR.004	5	Clarification of referencing to “Russian Scientists”
EBT.SL.GYR.005	5	Clarification on definitions and eliminating discrepancies
EBT.SL.GYR.006	6	Assessment of effects of lacking historical seismic data
EBT.SL.GYR.007	6	Clarification on methodology on determination of maximum magnitude
EBT.SL.GYR.008	6	Definition of methodology on determination of magnitude recurrence
EBT.SL.GYR.009	1	Lacking information on subcontractors and plant layout
EBT.SL.GYR.010	6	Referencing and interpretations of hydrogeological previous studies
EBT.SL.GYR.011	5	Definitions of parameters used on hydrogeological analyses
EBT.SL.GYR.012	5	Definition of input and parameters of flood analysis
EBT.SL.GYR.013	5	Information on possible sources of service waters
EBT.SL.GYR.014	9	Determination of emergency planning zones
EBT.SL.GYR.015	9	Presentation of SULTAN, the atmospheric dispersion model
EBT.SL.GYR.016	9	Provision of some dose conversion factors
EBT.SL.GYR.017	9	Providing the reference of most credible accident

### 3.3. Problems Encountered during Review and Assessment

Main generic problem encountered was inevitable translation used in communication and on information exchange with the APC. TAEK has made a regulatory decision<sup>1</sup> in early stages of the project and requested that the all technical documentation need to be in English. All documents of TAEK prepared in English is translated to Russian, while all documents of subcontractors, such as designer, etc., is prepared in Russian and translated into English. There were important mistranslations of information and details.

Choosing to discuss the findings, and their solutions in working groups, however, has led to two important problems. First problem was the lack of official records of issues and solutions of APC. Since the minutes of meetings were not recorded everything discussed in working group meetings, records of issues and solutions were limited with the review reports of site group members. Second problem was the keeping track of document revision activities. Within the process, multiple unofficial versions of separate chapters were provided to TAEK, creating an important and cumbersome task of follow-up of revisions, and unrevised sections. With each version provided, whole document was need to be reviewed to ensure that any irrelevant changes were not to be made. As a result, this approach were deemed inappropriate for other applications of bigger scope, and as a solution to the problem a draft on “Guidelines on Authorization Applications for Nuclear Power Plants” were developed. Applications will be required to be in compliance with this guidelines in upcoming stages.

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<sup>1</sup> Letter to APC dated 13.10.2011 and numbered B.15.1.TAE.0.10.01.00-120.02[ANS]-2019-14024  
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## **Section 4. Updated Site Report and Its Evaluation**

The Site Report is the document for regulatory body in which the owner demonstrates that the site has no rejection criteria for establishing a nuclear installation and complies with the safety acceptance rules. It is the main document based on which the site license is issued in regular cases. However, since Akkuyu site has been licensed in 1976, TAEK only requested APC to update the site report [1] on which the license is based in accordance with current regulations with current data, current safety concerns such as lessons learned from Fukushima Accident, current studies and current project. Affirmative result of review and assessment of Akkuyu Updated Site Report would practically mean relicensing of site and ensuring that the up to date data is considered in the design of proposed NPP.

In this respect, review and assessment of USR has been performed in great detail with respect to most recent safety requirements. The results given in this report are based on review and assessment of USR submitted on June 26, 2013 and are presented chapter-wise.

### **4.1. 4.1 Introduction**

This section of USR should introduce the site and provide basic information about the project, according to the format and content guidelines. This section, according to article 9 para. 1 of the Decree, should contain;

- a) Information regarding the utilization of the nuclear reactor facility to be build, its approximate power and among which reactor types it will be selected,
- b) Information regarding the technical capability, know-how and experience of the applicant and institutions carrying out site studies on behalf of the applicant, and
- c) Layout alternatives depending on the reactor types considered.

According the review and assessment, additional information needed on subcontractors used for site investigations, and tentative layout of the proposed plant, which were completed. With the final version of USR, information on utilization of nuclear reactor, approximate power, information on subcontractors, information on proposed design, and tentative layout of units were provided under subsections 1.1 through 1.5, respectively [27].

From these information, it is understood that the four units of VVER-1200 with 3200 MW<sub>th</sub> and 1200 MW<sub>e</sub> will be installed for electricity production. Additionally, information on total site area, maximum heights of some buildings from sea level, total cooling water capacity, etc. were provided.

Akkuyu NPP Electricity Production JSC was introduced as owner and address and communication information have also been provided. Information on technical capacity, experience in building and operating nuclear power plants of main shareholder, "Rosenergoatom" and its subsidiaries (Atomenergoremont, Atomtechexport, Baltyiskaya, vb) were provided. It is understood that the nuclear and turbine island design will be provided by Atomenergoproekt, reactor design will be provided by Gidropress, research activities will be

carried out by Kurchatov Institute and construction will be carried out by Atomstroyexport. Detailed information about these contractors and their responsibilities were also given.

Main contractors of the APC for site investigations were Atomenergoproekt JSC, Energy and Environmental Investments Inc. (ENVY), and Worley Parsons Nuclear Services JSC. ENVY and Worley Parsons were used several subcontractors, which were given in Table 5.

Table 5. Subcontractors of APC for Site Investigations

COMPANY	AREA	COMPANY	AREA
BAYAR	Drilling/Geophysics	DERİNSU	Marine Hydrology
DUZEN/TAEK	Laboratory Analysis	TOKER	Drilling/Engineering Geology Tests
BELİRTİ	Surface Geophysics	ELİTE	Meteorology
KANDİLLİ	Seismic Hazard Analysis	METU	Tsunami
FUGRO/ Anatolian Geophysics	Offshore Geophysics Studies	RIZZO	Seismic Hazard Analysis, Tsunami, Human Induced External Events, Emergency Planning, Population, Radioactive Material Dispersion

APC has considered two alternative layout plans. While units are placed toward the southeast of site in the first alternative, units are placed from west to east in second. APC states that second alternative was chosen based on the consideration of excavation work needed, potential problems of water discharge connections, arrangements for connection to main grid and dispersion of gaseous emissions from conduit.

Consequently, the information provided in USR has been found satisfactory and all issues of this chapter has been considered as resolved [27].

## 4.2. Geography and Population

This section of USR should provide information on location and ownership of site, population around the site, emergency planning zones, and land use characteristics around the site. This section should contain;

- a) Regional map clearly indicating geography of the selected site and other detailed maps giving characteristics of surrounding area of reactor, and
  - b) Prospective population distribution,
- according to article 9 para. 1 of the Decree, and;
- a) Population distribution and intensity, and other site area characteristics which may affect implementation of emergency measures, and
  - b) the projections in the population during lifetime of the plant,
- according to article 5 and 10 of the regulation, respectively.

Upon review and assessment of first USR submitted, a set of information that need to be provided has been found lacking. Among those are missing information on land use, location of gaseous and liquid discharges during normal operation, population centers for the purpose of emergency planning zone. Also, it has been requested to increase the quality of some maps

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provided since either they are not clear enough to read necessary data or have inconsistent data with the text.

In the last USR, regarding the population distribution and projections,

- a) Data relating to population centers within the Mersin Province, and in and out flux of population,
- b) Population of centers within 100 km radius,
- c) The population of villages within the Emergency Planning zone and distribution of population with respect to age, of centers within 30 km radius,
- d) Data relating to centers with population higher than 25 000 around the site, and distribution of population by age and annual growth rate,
- e) Distribution of population around the site with respect to geographical sectors (with 5 and 10 km intervals), and
- f) Distribution of disabled people with respect to villages around the site

have been provided.

USR has provided the information on prediction of age distribution of population in Turkey, has predicted that the nearby population around site will increase by 4 500 with the plant personnel and their families, and total population will reach to 15 000 by development of social life.

Additionally,

- a) A high resolution map of region,
- b) A map that shows topographical characteristics of site and vicinity,
- c) A map of agricultural production, sectorial maps of 20 km radius and emergency planning zone, map of population centers within 100 km radius, and
- d) A map demonstrating locations and orientations of reactor and turbine buildings and auxiliary buildings

were also provided with USR, As appendices, regional maps of 1:500 000, 1:250 000 scales, detailed maps of 1:10 000, 1:5 000 and 1:2 000 scales, geological maps of 1:25 000 and 1:500 000 scales and maps for various purposes were given.

As the result of review and assessment process, it has been found that all issues were properly addressed in this chapter with adequate information [27]. Provision of information on population projections and liquid and gaseous release points in normal operation together with the Site Parameters Report in following stage has been found acceptable (App III).

### **4.3. Nearby Industrial Installations and Activities**

This section of USR should provide information on location of all facilities and activities that may affect the plant, potential effects of those facilities and activities, particularly including all pipelines, waterways, flight routes, etc., and projections on industrial development around the site.

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Also, assessment of man induced external events such as airplane crash, fire, explosions and failure of dams, need to be provided in this chapter to comply with the article 9 of the Decree. The article 13 of the regulation requires the owner to assess potential effects of all installations and activities within 10 km radius to nuclear safety of plant. The same article lists of installations or activities that need to be considered for their effects of nuclear safety, such as chemical plants, mines, airports, military installations, etc..

article 14 of the regulation, the information regarding the nearby facilities and activities need to be completed with determination of possible dangerous events they may have, and estimation potential danger and effects on the nuclear installation.

Additionally, article 10 of Guidelines on Specific Design Principles, stating;

- a) There should be no airport within 10 km radius from the installation and no air corridors above the site leading to and from nearby airports, and
  - b) There should be no air corridor above the 5 km radius from the installation,
- were also used as criteria in review and assessment.

In this chapter, the missing information in first USR on potential effects of installation to the plant, identification of facilities and activities on a map, developments in nearby industry and increase in traffic in water and air transportation have been requested from APC.

In section 3.1 of USR, it has been stated that there is no facility, electromagnetic field or source, or eddy current source that may affect the plant within 10 km radius.

In section 3.2, it has been stated that there is a paper processing facility of SEKA at 35 km, and other installations are farther than 90 km. to the plant, located between Adana and Mersin. It had been added that the most of the facilities that have received permit within last five years are farther than 10 km to the plant. Similarly, there were no railway within this region and any traffic or train station.

There are mining facilities within the limits of 10 km zone, such as Koçaşlı stone quarry, 13 more sites licensed for mining operations, among them, one site is in exploitation, and works are planned at the other three sites. There are minerals exploration permits issued for 64 more sites within the same region. Additional information have been provided that there is an petroleum storage site in 80 km northeast, which belongs the Ministry of Defense, that the closest military base at 150 km, near Adana, and that the nearest harbor for use of military ships is at 30 km northeast.

In section 3.3, it has been stated that there is no gas or oil pipeline or any pipeline of combustible or explosive content, within 10 km to the plant.

In section 3.4, it is given that there is no facility which its explosion may affect the plant, that there are two gas stations beyond the Büyükeceli hills, and they may not have an event effecting the plant.

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In section 3.5, it has been stated that within 10 km radius, there is no sea transportation, including the dangerous goods. There is a fishing bay at 11.8 km east, Yesilovacik, and another at 19/5 km west, Aydincik fishing bay. There is a harbor for fishing boats at Yesilovacik only.

In section 3.6, the closest airports are given as 180 km east in Adana and 110 km west in Gazipaşa, stating that there is no civil or military airport within 10 km of plant. Additionally, the information about the air corridors, coordinates, flight heights and airplanes types that use these corridors are given for 10 km from the plant. Closest military air corridor is given as 30 km from the plant.

Fire and explosions were addressed in sections 3.1 through 3.5 in detail, and dam failure is addressed in chapter 5 of the USR.

The information provided with USR has been found adequate [27]. Suggestion of APC to address the projections on developments within the context of Site Parameters Report has been found acceptable (App III).

#### **4.4. Meteorology**

This chapter of USR should provide regional, local and on-site meteorological data, in more detail as it focus on site, short and long term atmospheric dispersion analyses, and potential meteorological events.

According to article 9 of the decree, meteorological characteristics of site and their analyses shall be provided. Additionally, article 8 of the regulation requires the provision of meteorological data that contribute to determination of pathways in which the radioactive releases can reach to public and environment.

Article 16 of same regulation requires the peak value analyses of regional wind speed, precipitation, snow packages, temperature and sea level for last 30 years. Analyses need to be performed based on data collected at 10 m for separate meteorological years suitable for parameter.

Article 17 samples the meteorological events that need to be taken into account for analyzing the effects of such events on the plant as tornado, drought, sand storm, lightening, hail, avalanche, etc.. While the basic data need to be provided in USR, it is acceptable to present the results of the analyses in Site Parameters approval stage.

Main findings of USR were insufficient referencing, completeness and consistency of information, and they were remedied. In analyses of routine releases, meteorological data collected from 60 m on site between 2009-2001 have been used to comply with the requirements of the decree. For the radiological consequence analyses of the maximum credible accident scenario, worst meteorological conditions were used for “envelope approach.”

Additionally, it has been stated that the meteorological data is collected by the two onsite 10 m stations and SODAR, and relevant data has been provided in USR. Together with these onsite data, long term information on regional meteorological conditions, wind, precipitation,



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temperature, humidity, atmospheric pressure, atmospheric stability and solar radiation, were gathered from the Silifke and Anamur stations.

It has been understood that the extreme values analyses were based on Silifke and Anamur stations data. Because of the regional characteristics, extreme value analyses was not performed for snow package, while sea level and its extreme values were handled in Chapter five of USR. These analyses were based on 30 years data as it was required. However, it has been found that the sea level analyses was based on eight year data. This finding was deemed as minor and compliance is requested at the Site Parameter approval stage. Analyses were performed with techniques compliant with the relevant provisions, and recurrence periods and confidence intervals were also provided.

Within the context of meteorological events, tornado, dust storms, thunderstorms, fog and hail were investigated and presented in USR. Tornado and waterspouts were also given. USR presents information on number of observance, date and frequency data for these events. Tornado data includes all occurrences within 150 km from the plant. These data has been reviewed and found adequate and in compliant with the regulations.

According to IAEA mission report, a decrease has been observed in average wind speed at nearby stations from 3.3 m/s to 1.3 m/s since 1975, which need to be investigated. If this measurements do not based on faulty equipment, then there may be safety considerations of stagnant atmospheric conditions, which may result in unacceptably high consequences of potential radioactive releases. The clarification made by APC upon request made by TAEK was that the main reason behind the wind velocity reduction trend during the considered period was the urbanization and structural development around the meteorological stations. Upon discussions, the clarification has been deemed adequate.

In addition to above issues, consultants of review team suggested that further investigations on site is needed for determination of land-sea breeze effect, and data needed to be collected from onsite station for analyses. The APC proposed to perform relevant measurements by moving one of the meteorological towers inland, and include the results in the Site Parameters Report. This proposal was accepted (App. III).

According to the review and assessment, USR has been found adequate and it has been decided that there is no meteorological data that would lead to rejection of site [27].

#### **4.5. Hydrology**

This section of USR should provide information on general hydrologic characteristics of region, dispersion of radioactive materials, sufficiency of water sources, potential hydrological events such as floods, and various characteristics of water bodies around the site, as applicable.

To satisfy the article 9 of the decree, information and studies regarding hydrological and some meteorological characteristics of selected site, information about the evaluation of the site with respect to natural phenomena such as floods and also its secondary effects, and information

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regarding adequacy of water sources to be used for cooling water purposes shall be given in this chapter.

APC provided also considerable amount of data on hydrology of the site. However, there has been a generic problem of clarity, coherence and consistency in this chapter. The information provided in this chapter was not flowing logically, and needed considerable amount of editing work. There has been inconsistent use of terms, and inadequate referencing.

This chapter of USR has been rewritten to remedy the need for newer data, better presentation of groundwater system of site, better presentation of mathematical models used for dispersion of materials, and a need for complete paleotsunami study.

In section 5.1 of USR general hydrosphere structure of Akkuyu site was given. Surface waters, potable waters and water analyses were also given. Information on underground waters, were addressed in Chapter 6 of USR.

In section 5.2, dispersion of radioactive materials were discussed in general. Models regarding the transportation of radionuclides with surface waters, dispersion of discharge water within the marine environment, and the marine pollution in normal operation and emergency conditions from the release of gasses and particles were given. Methods were given to calculate the plant originated radionuclides in filtered waters, suspended matters, seabed, shorelines and beaches.

In section 5.3, adequacy of water resources, including the water source for cooling of plant have been discussed.

It had been estimated that 8800000 m<sup>3</sup>/hr of water would be needed and it will be provided from the sea. Biological and hydrological studies of water intake and discharge facilities will be clarified at design stage. Daily need for 660 m<sup>3</sup> potable and 2280 m<sup>3</sup> service water were estimated. Decision of use of seawater for firefighting purposes will be made at design stage. Further need for water will also be clarified at that stage.

Mediterranean Sea has been defined as ultimate heat sink of the plant. Studies on water temperature, physical and chemical characteristics of seawater and seabed sediments were presented, in accordance with Regulation on Water Pollution Control.

Sea level observations covers the data recorded from May 30, 2003 to Sept. 16, 2011, amounting to 8 years. The article 16 of regulation requires the extreme value analyses to base on 30 years data. This study will be resubmitted at Site Parameters Report for amended with data from full time interval.

In section 5.4, flood was discussed. Possible flood scenarios were determined. In accordance with article 18 of the regulation, possible events that may lead to flood and potential effects of flood was investigated separately for sea, dam failure and stream basins. Tsunami has been identified as design basis flood, and previous and recent analysis have been investigated using probabilistic and deterministic methods. Oceanographical, hydrological, meteorological,

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topographical and seismic data have been gathered for flood analyses on shorelines. These data have been presented in maps, graphics and tables.

It had been identified that there is no dam, which its failure may pose a flood threat at Akkuyu site. Closest dam is Gezende Dam at 53.3 km. Freezing of water intake systems is not a plausible scenario for Akkuyu.

Information provided in USR has been found adequate and it has been deemed that there is no hydrological reason that may lead to rejection of site [27]. Provision of conceptual hydrogeological model and dispersion models in detail within the context of Site Parameters Report has been accepted (App. III).

#### **4.6. Geology, Geophysics and Seismology**

This section of USR should provide information in three different scope. For regional scale, stratigraphic and tectonic data and structural characteristics of underground should be provided. For environs of the site, information should be provided on geological and geomorphological characteristics of close vicinity of the site, local faults, underground water bodies, past cave-ins and landslides, etc. For the site, more detailed information on geological, geotechnical, hydrogeological characteristics should be provided. Additionally, seismological, surface faulting, liquefaction, and slope stability characteristics of site should to clearly be explained.

Based on the importance of subject for our country, requirements and acceptance criteria has been comprehensively addressed in national regulations. To comply with the article 9 of the decree, information and studies regarding geological, geotechnical and seismological characteristics of selected site, and information about the evaluation of the site with respect to natural phenomena such as earthquakes and also their secondary effects need to be introduced in this chapter.

According to the article 19 of the regulation;

- a) The seismological and geological conditions in the region and the engineering geological aspects and geotechnical aspects of the proposed site area shall be evaluated, information on historical and instrumentally recorded earthquakes in the region shall be collected and documented,
- b) Regional investigations, with taken into account the size of the relevant region will vary depending on the geological and tectonic setting should be determined two level studies which radial extent will typically be 150 km or more, regional studies and include a geographical area typically not less than 25 km in radius, near regional studies,
- c) Site vicinity studies should cover a geographical area typically 5 km in radius,
- d) Site area studies should include the entire area covered by the plant, which is typically 1 km<sup>2</sup>,
- e) Where compiled data are inadequate for the purpose of delineating seismogenic structures and verifying database, it should be done new geophysical site studies such

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as seismic reflection or refraction, borehole, trench and paleoseismological investigations,

- f) Sites with complex geology and inadequate data on seismicity, not only historical and instrumental records but also a network of sensitive seismographs having a recording capability for micro-earthquakes should be installed. The minimum monitoring period should be two years considering long low seismicity related to some faults,
- g) For the determination of seismic hazard, seismotectonical regions shall be defined, and appropriate attenuation functions shall be used to estimate the ground motion at site.

Article 20 of the regulation requires the evaluation of surface faulting with sufficient and detailed methods and investigations for proposed site, and should there be a surface faulting that may affect the safety of plant, seeking alternative sites based on reevaluation if feasibility of construction and safe operation. Additionally, article 9 of the Guidelines prohibits the construction of nuclear power plants if there is an active fault on site.

Article 21 of the regulation requires the consideration of potential for slope instability such as land and rock slides and snow avalanches that could affect the safety of the plant, and should there be such a potential, the hazard need to be evaluated by the use of parameters and values for the site specific ground motion.

Article 22 of the regulation requires the investigation of the region for the existence of natural features such as caverns, karstic formations and human induced features such as mines, water wells and oil wells, for the potential for collapse, subsidence or uplift of the site surface. Should there be no practicable engineering solutions for an identified potential for collapse, subsidence or uplift of the surface that could affect the safety of the nuclear power plant, regulation requires the rejection of site.

Article 23 of the regulation requires the investigation of the potential of liquefaction by using the site specific ground motion parameters with analytical methods and accepted soil investigations methods. As a result of investigations and analysis, if the potential for soil liquefaction is found to be unacceptable, the site shall be deemed unsuitable unless practicable engineering solutions are demonstrated to be available.

This chapter practically rewritten for the final USR [7]. In this USR, section 6.1 introduces the regional tectonic and geodynamic framework, section 6.2 introduces the site vicinity surveys, section 6.3 introduces site surveys and geotectonic studies, section 6.4 introduces seismic data, section 6.5 discusses seismic hazard analyses, section 6.6 addresses issues on surface faulting, section 6.7 addresses the liquefaction phenomena, and section 6.8 addresses the slope stability.

The USR provided the results of regional studies for 300 km radius and close vicinity studies for 25 km radius in geological cross-sections and maps of 1:500000 and 1:25000 scales. It also includes the information on the tectonic structure of the region, faults in this regions, types, characteristics, displacements and interrelations of these faults, and recent seismic activities.

The geological and geomorphological characteristics of close vicinity of the site have been discussed in this chapter and were given in maps of 1:5000 scale. From general geological view

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of Akkuyu, the site is located in mid-south of Taurus range in between the Ecemiş Fault on east and Hadım nap on west. Typical cross section of Büyükeceli formation which reach to Akkuyu site can be observed on Silifke-Anamur road, 1 km to the village of same name. While the thickness of Büyükeceli formation is about 630 m, it decreases towards the east and composed of eight sub-members. Hills of 170-270 m height surround the site, and there are tree bays carrying the same name with Akkuyu, Aksaz and Çamalanı. In 2011, high sensitivity off shore seismic studies have been carried out within the context of site vicinity.

The USR also discusses the results of onsite detailed investigations, in compliance with the regulations, for 1 km<sup>2</sup> area, including geological structure of site, physical and mechanical characteristics of soil, electrical and seismic characteristics, methods and analyses to determine these characteristics, hydrogeological conditions, underground water dynamics and aquifers. In 2011, several boreholes were drilled at different depths up to 150 m, centering around reactor, in accordance with the article 24 of the regulation. The characteristics of boreholes with coring, and cores were given in tabulated form under section 6.3.3.2 of USR.

In section 6.3, boreholes for different purposes, related tests, and seismic methods utilized have been discussed in detail. Within the context of Paleoseismological studies, ten trenches were investigated, T1 through T4 onsite, T5 through T8 on Akkuyu fault, and T9 and T10 on Aksaz fault, in 1983 by Middle East Technical University. In 2011, ENVY further studied the region with 4 new trenches, T1 and T2 on Akkuyu and T3 and T4 on Aksaz fault, considering the distribution of Quaterner deposits. In 2011, a seismic measurement network of 12 stations was established to define the existing faults and determine the seismic activities on site and at 5 and 40 km. This network is composed of seven strong motion accelerometer and six weak motion wide-range seismometers.

USR states that, during the investigations, no natural or human induced characteristic that may lead to cave in or subsidence or wide karstic caves that may affect the safety of the plant could be identified. Basically, two types of karstic structure were observed. First type was small, 1-2 cm cavities called pea-karsts. Second type was the expansion of existing discontinuities. Karstic cavities may expand to a few centimeters, posing no threat on plant that cannot be solved by engineering measures.

Six different models had been developed by the different subcontractors of APC to determine the seismotectonic structure of region. First model developed by ENVY/KOERI (Kandilli Observatory and Earthquake Research Institute) within the context of “Middle East Earthquake Model” and “Europe Harmonization of Seismic Hazard.” Second model is an update of model developed by METU/EERC (Earthquake Engineering Research Center of Middle East Technical University.) Third model is developed by adding the Ecemiş fault as a different and narrow zone assuming it continues to south. In USR, it has been stated that to investigate the continuity of Ecemiş fault to south, geological and geophysical studies were carried out. According to USR, no indication has been identified which shows that the Ecemiş fault extends towards the sea. Fourth model was developed by IPE RAS (Institute Physics of the Earth, Russian Academy of Science.) This model is composed of eight different seismotectonic (ESO, Earthquake Source Occurrence)

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zones. Another model is developed by Worley Parsons, considering the important tectonic motions within 350 km radius. Within the model, total of 14 zones including Akkuyu site has been used. The last model is developed by RIZZO and is composed of 16 ESO. This model establishes main zones and subzones under them. Hazard assessment has been performed by four different groups, ENVY/KOERI, IPE RAS, RIZZO and Worley Parsons. Logic tree has been used by all groups.

In seismic hazard analyses performed by ENVY/KOERI, equality of four ground motion estimations had been used [28, 29, 30, 31]. The given equalities were found to be applicable to regions with more of shallow crust earthquakes. Three intensity prediction models were utilized for the computation of the probabilistic intensity distributions. In seismic hazard analyses performed by IPE RAS, the six ground motion estimation equation had been used [28, 29, 32, 33, 34, 35]. RIZZO, on the other hand, seven equation had been used on calculations for seismic hazard analyses. Ground motion prediction;

- a) Shallow crust earthquakes [29, 31, 33, 36],
- b) Earthquakes on subduction zones [31, 36, 37].

Worley Parsons had used four equations for calculations;

- a) Shallow crust earthquakes [29, 31],
- b) Earthquakes with focal point in subduction zones [36, 37].

Seismic hazard had been assessed by APC, in accordance with IAEA SSG-9 Guidelines [24], using deterministic methods together with probabilistic assessments.

In section 6.6 of the USR, information on surface faults were given systematically from regional scale to site scale, including offshore. The issue was addressed through the morphotectonic investigations, offshore studies, paleoseismological investigations and Quaternary deposits. It had been demonstrated in USR that there is no surface faulting on site to affect the safe operation of the plant and no active fault exist on site by interpretation of air photographs, site investigations, geophysical study on land and offshore, and paleoseismological studies.

In section 6.7, it had been stated that the ground on which the units will be erected is bedrock with no liquefaction potential that may affect the safety of the plant. However, to estimate the potential results of any failure of non-safety structures, systems and components, a liquefaction potential of all site will be assessed. Additionally, it had been stated in USR that while designing for the plant infrastructure and emergency response plans, liquefaction will be considered for emergency and accessibility issues on site.

Section 6.8 addresses the slope instability. According to USR, there is no instability on natural slopes of the site due to the dense pine trees and thin soil.

It has been deemed that the USR adequately demonstrates, within the scope of relevant regulations, the acceptability of site based on the geological, geophysical and seismic characteristics, given in regional, site vicinity and site scales, and that there is no site characteristics which may lead to rejection of site [27].

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#### **4.7. Ecological Effects**

This section of USR should provide information on possible effects of flora and fauna on the plant. Particularly, the actors that may have potential effects on nuclear safety should clearly be defined.

In this respect, the USR has information about the hydrobionts in seawater, which may affect the water intake mechanisms during the operation, but no other information has been provided regarding the flora and fauna around the site. Regarding the danger posed by aquatic life in seawater, APC declared that the engineering solutions will be provided at the design development, including the biological fouling.

Since the regional flora and fauna have not posed an imminent threat to plant safety establishing a basis for rejection of site, the USR has been deemed adequate [27].

#### **4.8. Human Induced External Events**

This section of USR should provide information on possible scenarios of external events based on information provided earlier on facilities and activities around the site, and analyses on their potential effects on safety of plant.

In this section, to comply with the article 9 of the Decree, information about the evaluation of site with respect to human induced external events such as crashes, fires, explosions and failure of dams, etc. need to be given. Details of this requirement were laid out in article 14 of the regulation, stating that the all information about hazard sources of each identified facilities and activities need to be gathered to determine possible scenarios which may pose a danger to the plant, the danger itself and their effects on the plant. The same article gives examples of event that need to be considered as explosions, delayed ignition of flammable gasses, release of poisonous or asphyxiating gasses, or radioactive materials, fires, crashes on water intake systems of plant or plant itself, eddy currents, or electromagnetic interference, etc.

On the other hand, the article 10 of the Guidelines on Specific Design Criteria, states that;

“Following principles shall be considered in design regarding the aircraft crash within the context of external events that may affect the nuclear power plant:

- a) An airport shall not be located within 10 km radius from the plant, and approach and take off paths of airplanes for nearest airport shall not pass over this area,
- b) No air corridor shall pass over the 5 km radius area from the plant,
- c) During the design of nuclear power plant, necessary measures shall be taken to keep the Type A aircraft crash within design basis accidents, and Type B aircraft crash within the design extension conditions,

with Type A Aircraft is being a craft weighing at least 20 tons and has 200 m/s speed, and Type B Aircraft is being a craft weighing at least 400 tons and has 200 m/s speed, while all other parameters are determined by the owner.”

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In this context, in section 8.1, sources for explosions are listed as transit vehicles of roads, stone quarries, gas stations and ships. In calculation of SDV (Screening Distance Value) of explosions, APC has used the methodology given in RegGuide 1.91 of Nuclear Regulatory Commission (NRC) of USA, assuming “peak positive incident overpressure” as 6.9 kPa (1 psi) stating that this conservative value had been chosen by NRC.

For the explosion in land vehicles, maximum explosive cargo load has been assumed as equivalent to 23 tons of TNT, and the distance for 6.9 kPa had been calculated as 511 m. Since the closest highway is at 2260 m from the site, and hence an explosion on closest highway would not have an effect on site.

Regarding the explosions of stone quarries, it had been given that the nearest quarry is at 8.3 km and potential danger are the explosive materials used. It had been calculated that the only explosives equivalent to  $9.8 \cdot 10^7$  kg TNT might create a pressure of 6.9 kPa from that distance. In USR, it had been stated that using this amount of explosive is not realistic and an explosion in nearest stone quarry do not pose a threat to the plant.

For the gas stations, nearest station had been identified as at 3.3 km on Büyükeceli highway. In USR, it had been stated that the any explosion in this gas station might not affect the plant due to its distance to the plant.

In section 8.2 of the USR, regarding the delayed ignition of flammable gasses and dispersion of radioactive materials, poisonous and asphyxiating gasses, is had been stated that there is not an activity that may cause release of such materials, and natural geographical conditions of Akkuyu would protect the power plant from such dispersions. Additionally. It had been stated that there is no transportation of such materials, including maritime transportation, within 10 km of the plant.

In section 8.3 of USR, regarding fires, there is no industrial installation that may cause fire within 10 km. However, Akkuyu site had been surrounded with forests of pine trees with needle type leaves with no under bushes. The site had been identified as Class 1 sensitive area for fires, and statistical information on forest fires were given.

In section 8.4 of USR, regarding the collision with the water intake systems, it had been stated that there is no transportation of dangerous materials with ships within 10 km, and there are only touristic and fishing boats.

In section 8.5, regarding the crashes on the plants, statistical data for aircraft accidents from 1957 to 2007. It had been stated in USR that there are civil air corridors within 10 radius from the plant and military corridors within 30 km, however, the General Directorate of Civil Aviation (GDCA) agrees to change the air corridors. It had been stated also that the design will comply with the Russian regulations [38] and criteria laid out in the Guidelines on Specific Design Principles. Detailed information on air transportation had been provided in section 3.6.

In order to consider the plant’s effect on airports and air corridors, The General Directorate of National Airport Administration inquired the information on potential areas that flight



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restriction will be applied, on March 21, 2011<sup>2</sup>. TAEK has provided their relevant criteria in their response on May 13, 2011<sup>3</sup>. The GDCA requested the Min. of Energy and Natural Resources, to provide information on when the flight restriction should start. The request conveyed to TAEK<sup>4</sup>. In the letter, the GDCA stated that the two air corridors belonging to Air Force had been altered for not affecting the Akkuyu site. TAEK has responded to the GDCA stating that the flight restriction on Akkuyu site can start with the granting of Construction License to first unit<sup>5</sup>.

In section 8.6 of the USR, regarding the dispersion of liquid and solid effluents, it had been stated that there is no installation within 10 km radius that may release corrosive liquids. Such wastes may only be produced in towns of this region and some of these towns do not have waste processing facility, including the closest one, Büyükeceli. In Büyükeceli, wastes are collected in septic tanks and used in irrigation of forests. It had also been stated that there is no marine transportation of dangerous goods within 10 km radius, and information on accidents with petroleum spill will be provided at design stage.

In the same section, regarding the eddy currents and electromagnetic interference, it had been stated that there is no installation within 10 km radius that may create electromagnetic waves.

Upon review and assessment of final USR, it has been concluded that there is no human induced external event that could not be solved by engineering measures and that may establish a basis for rejection of the site [27]. However, APC will provide full probability calculations, and evaluation of potential hazards at the approval stage of site related design parameters. That report will also include information about oil transportation routes beyond 10 km (App. III).

#### **4.9. Radiological Impact of the Plant**

This section of USR should provide information on radiological effects of plant on environment in normal operation and accident conditions, particularly for maximum credible accident, based on the atmospheric dispersion introduced in previous chapters.

Since this chapter of USR needed the most information about the design, it has been the chapter that created most difficult problems. TAEK accepted the use of technical data from reference plant, since the Akkuyu design is yet to be completed.

In this section, to comply with the article 9 of the decree, information about the Preliminary studies of the radiation exposure of the public due to the liquid and gaseous radioactive effluents during normal, anticipated operational occurrences and accident conditions which should take into account dispersion patterns of radioactive effluents into the environment, present and prospective population distribution, public water supply from the regional water sources, regional milk and food consumption, and radioecology.

<sup>2</sup> The letter dated 21.03.2011 and referenced B.11.1.SHG.0.11.01.00/100-19067

<sup>3</sup> The letter dated 13.05.2011 and referenced B.15.1.TAE.0.10.00.00-110.01[AKK]-852-07067

<sup>4</sup> The letter dated 16.12.2011 and referenced B.15.0.EGM.003.02.00/7215

<sup>5</sup> The letter dated 22.12.2011 and referenced B.15.1.TAE.0.10.00.00-110.01[AKK]-2530-17100

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On the other hand, article 8 of the regulation requires estimation of radiological releases and their effects, determination of pathways for releases to reach public and environment, and demonstration of estimated doses to be lower than limits defined in regulations. Article 9 of the regulation defines the maximum credible accident as a criteria for determination of emergency planning zones.

The GSR 3 [39] of IAEA the dose limits were defined as 1 mSv effective dose for public, while higher doses is allowed as long as average of last consecutive five years remains under 1 mSv. In addition to this limit, dose constraints can be applied for nuclear installations.

In this section, missing information on liquid and gas releases were completed, and a provision of reference report for supporting the scenario of maximum credible accident.

The information on gaseous and liquid releases during the normal operation and anticipated operational occurrences had been given in this section. Gaseous releases and corresponding effective doses at different distances from the plant had been given for different operational modes, such as operating at nominal power, cooling of reactor, and opening of pressure vessel. Additionally, liquid releases and corresponding effective dose estimates had been provided and information provided regarding the releases were found adequate.

The liquid releases had been compared with limits laid out for drinkable water by assuming that the no dilution occurred in activity of radioactive liquids collected in sump tanks, and it had been demonstrated that such releases may only cause, with a conservative approach, doses lower than 50  $\mu$ Sv/yr for four units. It had been stated that the detailed analyses will be provided with Preliminary Safety Analyses Report.

Two different assessment had been presented for atmospheric releases for normal operation and anticipated operational occurrences. The USR presents dose estimations at different distances from 800 m to 30 km for atmospheric releases. It had been stated in USR that the maximum release during normal operation occurs, with a conservative approach, during the maintenance period of the units. The activities of isotopes had been given in tabulated form, and claimed that the doses at 800 m from four units do not exceed 30  $\mu$ Sv/yr. For anticipated operational occurrences, assuming that it may occur at only one unit while others operate at normal operation, it had been stated that maximum public doses at 800 m for four units will remain lower than 83.8  $\mu$ Sv/yr, in compliance with the total dose constraints defined in Russian regulations. It had been stated that the detailed analyses for atmospheric release during normal operation and anticipated operational occurrences will be provided with Preliminary Safety Analyses Report.

In this section of the USR, dispersion of radioactive effluents to environment, and dose calculations for age groups 1-2 and adults, based on the demographic information provided in second chapter, had been provided. General information had been provided for utilization of local springs as potable water, and production of milk and foodstuff. It has been understood that all necessary information on local radioecological characteristics and data for dispersion of radionuclides in environment which will be used for calculation of dose estimates, had been

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provided. The compliance with the presenting the preliminary studies as stated in the decree had been demonstrated and the information provided in USR have been found adequate.

Additionally, the scenario for maximum credible accident had been defined, and it had been found acceptable, within the context of USR, based on the data provided for the Reference Plant. Radiological consequences of this scenario had been estimated by using site-specific meteorological data with an atmospheric dispersion model, in which the surface conditions are considered by a surface roughness coefficient.

The data provided in this section on normal operating conditions and accident scenario are only preliminary approaches and estimations since the Akkuyu design is yet to be completed, however, they will be finalized and verified during the course of licensing.

Based on the evaluations, the information provided in this chapter have been found adequate and deemed that there is no characteristic that may lead to rejection of the site [27].

Additionally, investigation of releases from radioactive waste disposal facility during normal operation and corresponding dose estimates, and detailed calculations of radiological consequences, performed by an atmospheric dispersion model capable of considering topographical conditions of site, effect of sea breeze and wet deposition, had been accepted to be presented in the site parameters report at the next stage.

#### **4.10. Emergency Planning**

This section of USR should provide information need for determination of the emergency planning zone, potential infrastructure to develop emergency plans, potential difficulties to implement the emergency plans.

The article 9 of the Decree states that the environment shall not be adversely effected more than the acceptable limits even in case of the maximum credible severe accident. Additionally, the article 9 of the regulation requires that the emergency planning zone shall be determined such that an individual on its boundary would not receive an effective dose in excess of 10 mSv over 2-day period or thyroid dose in excess of 100 mGy in case of maximum credible accident.

In article 10 of the regulation, the site characteristics that may hinder applicability of emergency measures or that may lead concentration of radioactive effluents at certain regions, high recurrence of natural events like fog, hail or inversion as reasons for rejection of site. Hence, applicability of emergency measures within the emergency planning zone shall be demonstrated for lifetime of plant including the anticipated changes in demographic data.

Main amendments in this chapter were to establish a consistency in terminology with the IAEA, and provision of missing information. In USR, the estimated emergency planning zone had been given based on the results of atmospheric dispersion model presented in section 9.1. The Emergency planning zone need to be updated with the finalization of Akkuyu design and enactment of National Radiation Emergency Plan.

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In the USR, the population that need to be evacuated had been provided and potential centers for evacuation had been identified.

In the USR;

- a) Geological and topographical factors such as landslides and rock falls,
- b) Hydrological factors such as on shore floods, river floods and heavy local precipitations,
- c) Meteorological factors such as snow storms, freezing rain, inversion, fog, tornado,
- d) Seismic factors such as seismic vibrations and fault displacements

had been identified as main reasons which may hinder the emergency measures to be taken.

In the USR, the probability of occurrence external events that are not initiating events had been assessed, and claimed that such conditions can be managed with planning, such as having evacuation roads already above the possible maximum tsunami height. However, it had been stated that the highways might need to be reinforced for earthquakes and alternative highways need to be constructed.

The APC had provided the current infrastructure for emergency measures. It had been estimated that identification on needs for evacuation routes, waterways, and emergency centers shall be performed based on these information.

According to the evaluation of TAEK, none of these issues was a characteristic that may lead to rejection of the site, and can be remedied by engineering measures. It has been deemed that there is no site characteristics, within the context of applicability of emergency measures, to reject the site [27].

Provision of regions in which the radioactive effluents may concentrate by estimating them with atmospheric dispersion models, capable of considering the topography, breeze effects and wet deposition, with the site parameters report has been accepted (App. III).

#### **4.11. Electrical System**

This section of USR should provide general information on connection possibilities to national grid and reliability of off-site power, to assure compliance with the article 9 of the Decree, added to the site report content based on need arisen.

Voltage levels of national grid and a diagram of 380 kV transmission lines were given in section 11.1.2 of USR, also showing the expansion plans. The number of transmission switchyards, their capacities and length of transmission lines had been given based on the voltage levels. Additionally, information on international interconnection system and a diagram on connection of Akkuyu site to 380 kV transmission line had been given.

In had been stated in section 11.1.3 that the plant will be connected to 380 kV line with six transmission lines, and to Akkuyu substation, which is connected to 154 kV distribution line, over the 380/154 kV autotransformer with 2 short transmission lines. The two 380 kV switchyards close to the site will serve twin units, and these will be kept physically separated but electrically connected to achieve highly reliable operation.

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It had been stated in section 11.1.4 of the USR that the auxiliary power for normal operation will be provided through two 80 MVA auxiliary transformers connected between the unit amplifier transformer and generator breaker. Additionally, there will be two 80 MVA capacity standby transformers for starting up and shutting down the units, and emergency.

In section 11.1.5, it had been stated that the plant will be connected to 154 kV distribution line through the 380/154 kV Akkuyu switchyard. This connection will be used both for transmission of produced power and provision of emergency power as alternative to 380 kV transmission lines.

In section 11.1.6, the national electric transmission lines, considering its number of high voltage transmission lines, switchyards, interconnections, adequate protection systems, and high-speed relays, are identified as reliable off site power source.

Based on the evaluation of given information, it has been concluded that the site has no characteristic that may adversely affect the acceptability of site [27].

#### **4.12. Programs**

This section of USR should provide information on how the quality of site investigations were ensured and managed.

The APC provided information about its general quality management system manual and plan and quality management system manual and plan for the site investigations. The information provided by APC on assuring the quality of activities have been found satisfactory. Additionally, the site investigations were inspected by TAEK and quality management of activities were found acceptable.

The quality handbook and quality plan of the quality management system for site activities have been reviewed by TAEK team. It has been identified by the review team that quality management system documents lacks the information about detailed site investigations while the site surveys to prepare USR were adequately addressed. This issue had been communicated with the APC.

On the other hand, it was found that, in Russian system, the information on quality management of the activities is provided to regulatory body at the end of the activity, while in Turkish system, it was asked to be provided in advance of activities. This difference in approaches caused APC to delay in submitting quality manual and plan to approval of TAEK.

The process has been handled by TAEK as a separate procedure from the USR. In USR APC provided enough information about the system and found acceptable by the TAEK experts [27].

#### **4.13. Additional Information**

In this section, APC has presented some additional information regarding its approach to lessons learned from the Fukushima accident, their contribution to the National Report of Turkey for European Union Stress Test. The outcomes of this approach will be considered in detail during the Construction License application.

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## Section 5. Conclusions

The site licensing in Turkey consist of two consecutive stages. The applicant should demonstrate that the site has no exclusion criteria, i.e a characteristic that lead to rejection of site based on preliminary site investigation. According to TAEK regulations, applicant should demonstrate in its site report that the there is no capable fault at site, the site has no geological, seismic, etc. characteristics that may hinder the construction or operation of a nuclear power plant, the site has no characteristic that may prevent the emergency measures to be implemented if need be, and the facilities and activities, such as industrial plants, airports, flight routes, etc., around the site has no insoluble adverse effects on plant.

The applicant, then as the second stage, need to perform more detailed investigations on site to determine exact values of site related design parameters, and submit a Site Parameters Report containing the results of detailed site investigations and exact values of site related design parameters, for approval of site parameters. These parameters can be used in design only after approval of TAEK.

The review and assessment of TAEK experts had been based on this approach, defining the shortcomings, deciding on at which stage the issue need to be addressed, and communicate the findings with applicant accordingly. In overall, all shortcomings will be addressed at siting stage as defined in the Decree on Licensing of Nuclear Installations.

The site report, which established the basis to the site license given in 1976, was also prepared in a similar approach. Hence, when TAEK issued the requirement of updating site report to reflect current data and project of the site within the License Conditions to the Site License of Akkuyu, it was expected that the APC would prepare an Updated Site Report accordingly. However, since it is almost a unique approach in international arena, there have been misunderstandings about the depth of information that TAEK expect at the stage of USR. These difficulties have been overcome by effective use of working group established with APC and TAEK experts.

The first USR submitted in May 22, 2012 had considerable shortcomings to TAEK's expectations. The generic problems such as poor translation, use of non-IAEA terminology, poor referencing, etc. resulted in considerable time losses during review and assessment. These generic problems were also pointed out by the independent reviewers of Advisory Committee of Nuclear Safety of TAEK, and IAEA review team.

Based on its own review and assessment, and recommendations received from ACNS and IAEA reviews, TAEK issued Additional Information Requests (AIRs) to the APC, a first of a kind method for TAEK adopted from international experiences. The responses to Additional Information Requests proved that the method need to be further elaborated. However, TAEK was able to adapt itself to such difficulties and developed better communication channels and conditions with APC to discuss and resolve issues.

In the end, APC has submitted the new version of USR on June 26, 2013 and this safety evaluation report has been prepared based on the thorough review and assessment of that USR

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[7]. With the review and assessment of USR, it has been determined that the site investigations have been performed adequately, the environment shall not be adversely effected more than the acceptable limits even in case of the maximum credible severe accident and any site characteristic shall not technologically preclude the construction of a nuclear power plant at the site.

As a result of working group communications with the APC, the issues itemized in Appendix III have been accepted to be provided with Site Parameters Report, based on the justification provided by APC that these issues do not impede the demonstration of acceptability of site.

In this respect, the Department of Nuclear Safety prepared this Safety Evaluation Report for Atomic Energy Commission, the decision making body of TAEK, to state that the Updated Site Report sufficiently demonstrates the acceptability of site, satisfies the requirements laid out in the relevant regulatory documents of TAEK, IAEA and Russian Federation, and that the site has no characteristic, which may cause the rejection of site.

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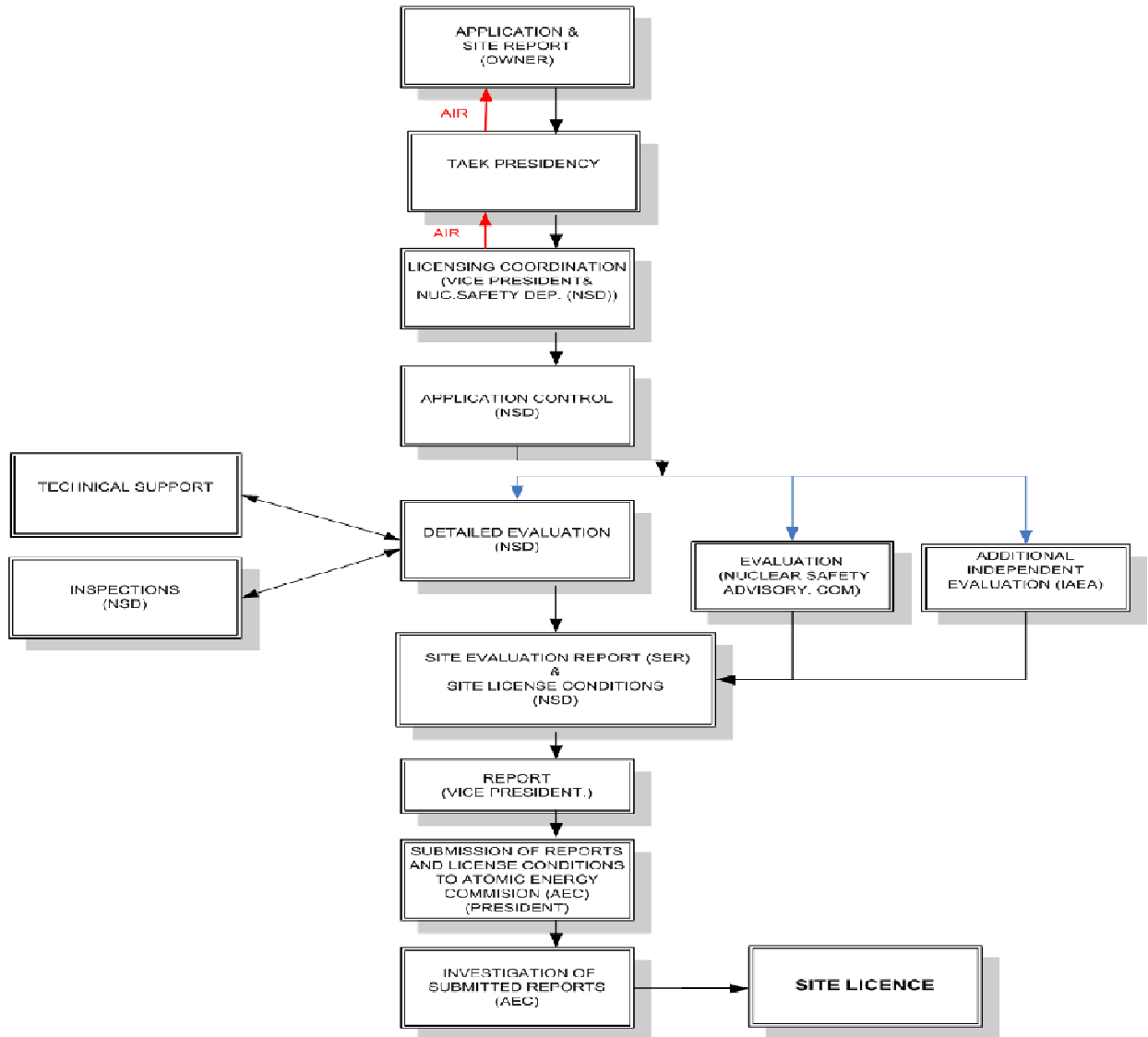
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### ANNEX I Flowchart of Review and Assessment Process



## ANNEX II TAEK Review Team

EXPERT	USR CHAPTERS											
	1	2	3	4	5	6	7	8	9	10	11	12
Mehmet Ceyhan (Head, DNS)												
Serhat Alten (Licensing Project Manager)												
Arif Kara (Site Group Coordinator)					x	x						
Yılmaz Bektur	x				x	C		x				
Özge Ünver				C					C	x		
Serhat Köse	C <sup>6</sup>				x	x						
Feridun İ. Saral												C
Barış Güner						x		C				
Gürdal Gökeri		C		x					x	C		
Batuhan İşcan					C	x						
Miraç B. Öztemiz			C		x							
Yusuf Gülay		x							x	x		
Mahmut Doğan			x					x			C	
Gürkan Biçer		x				x		x				
Sibel Ünlü							C					
Rauf Terzi					x							

<sup>6</sup> C defines the coordinator for each chapter

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### **ANNEX III Additional Issues to be Submitted with Site Parameters Report**

1. Detailed information on projections of demographic changes and release points of liquid and gas effluents at normal operation,
2. Projections on industrial development in the vicinity of site,
3. Results of determination of land-sea breeze and its analyses,
4. Detailed presentation of conceptual hydrological model and dispersion models,
5. Probability calculations of external events and impact analyses,
6. Information on petroleum transportation on maritime line beyond 10 km,
7. Investigation of releases from onsite radioactive waste management facility during normal operation and corresponding doses,
8. Use of atmospheric dispersion models capable of considering topographical conditions, breeze effects and wet deposition, etc., in detailed radiological consequence analyses.