****

**Отчёт о состоянии взаимодействия и оказания поддержки по критериям ВАО АЭС на АЭС Бушер в 2021г.**

**Report on the status of interaction and support per the WANO criteria for Bushehr NPP in 2021**

**WANO**

**Moscow Centre**

**Report**

**on the status of interaction and support per the WANO criteria for Bushehr NPP in 2021**

**Bushehr \_ C \_2021**

Bushehr

2021

**Confidentiality notice:**

Copyright © 2021 World Association of Nuclear Operators (WANO). All rights reserved. Not for sale or commercial use. This document is protected as an unpublished work under the copyright laws of all countries which are signatories to the Berne Convention and the Universal Copyright Convention. Unauthorized reproduction is a violation of applicable law. Translations are permitted. All copies of the report remain the exclusive property of WANO. This document and its contents are confidential and shall be treated in strictest confidence. In particular, without the permission of both the Member and the applicable WANO Regional Governing Board, this document shall not be transferred or delivered to any third party and its contents shall not be disclosed to any third party or made public, unless such information comes into the public domain otherwise than in consequence of a breach of these obligations. Furthermore, the circulation of this document must be restricted to those personnel within the Member organisations who have a need to be informed of the contents of the document.

|  |  |  |
| --- | --- | --- |
| **Approval Sheet**  **APPROVED BY:** |  | **APPROVED BY:** |
| **Bushehr Plant Director**  **\_\_\_\_\_\_\_\_\_\_\_ Reza Banazadeh**  **«\_\_\_\_»\_\_\_\_\_\_\_\_\_ 2021** |  | **WANO-MC Director**  **\_\_\_\_\_\_\_\_\_\_\_Vasily Aksenov**  **«\_\_\_\_»\_\_\_\_\_\_\_\_\_ 2021** |
| **AGREED:**  **Chief Engineer**  **\_\_\_\_\_\_\_\_\_\_\_ Mohsen Shirazi** |  | **AGREED:**  **WANO-MC First Deputy Director**  **\_\_\_\_\_\_\_\_\_\_\_Anatoliy Kirichenko**  **WANO-MC Deputy Director**  **\_\_\_\_\_\_\_\_\_\_\_\_Sergey Frolov**  **WANO-MC Deputy Director**  **\_\_\_\_\_\_\_\_\_\_\_\_Sergiy Vybornov**  **Head of WANO-MC Representatives Group**  **\_\_\_\_\_\_\_\_\_\_\_\_Vadim Tarykin** |
|  |  | **DEVELOPED BY:**  **WANO-MC Representative at BUSHEHR NPP**  **\_\_\_\_\_\_\_\_\_\_\_\_ Hamid Azarbad** |

**Methods to Determine Interaction and Support Levels**

**Goals of the process of determining the interaction and support levels (member station/utility categorization process)**

The primary goal of determining the interaction and support levels (member station/utility categorization process) is to ensure reasonable and efficient distribution of the WANO-MC’s and WANO members’ resources in the planning of WANO activities based on the achieved level (category) of interaction and support. A supplementary goal of the process is to identify member stations/utilities who are providing their administrative and other resources for the WANO-MC programmes to support those stations/utilities that need additional support.

**Main principles for determining the interaction and support levels**

* Interaction and support levels are determined based on current, credible inputs and well-defined criteria.
* The criteria should be objective, measurable and unambiguous.
* The criteria should be based on the results of implementation of the WANO-MC programmes.
* Stations in specific life-time phases need special attention.
* The determined interaction and support level refers to a particular station only, and is not intended for comparing it with other stations/utilities.
* The criteria are used to determine the following:
  + potential interaction and support levels for each plant/utility
  + recommendations on the use of the administrative resource.
* The WANO-MC Representatives prepare preliminary data on the criteria and additional information needed to determine the interaction and support levels.
* The WANO-MC Expert-Analytical Group prepares the following:
  + propose interaction and support levels for each WANO-MC member station/utility based on data per the criteria and available information on the plant performance and operating conditions
  + recommended scope of the administrative resource to be provided
* The WANO-MC Director takes consideration of the WANO-MC Expert-Analytical Team’s proposals and makes the final decision on the interaction and support level as well as on the scope of administrative resource to be provided for each WANO-MC member station/utility.

**Criteria used to determine the interaction and support levels:**

1. Fulfilment of WANO Membership obligations, as follows:
   1. Hosting WANO peer reviews.
   2. Submitting event reports to WANO.
   3. Submitting information on WANO performance indicators.
   4. Providing experts to participate in WANO programmes at WANO's requests.
   5. Providing experts to fill in WANO vacancies at WANO’s requests.
2. Operational performance:
   1. Post-peer-review WANO Assessment results.
   2. Status of AFIs from the previous peer review as assessed by the follow-up peer review team.
   3. Achievement of long-term goals for the key WANO performance indicators.
   4. Status of the key WANO performance indicators.
   5. Occurrence of “Significant” or “Noteworthy” events.
   6. Corrective actions developed for the AFIs identified during the peer review.
   7. Member Support Missions (MSMs) conducted for the AFIs mentioned in the Executive Summary of the peer review report.
   8. SOER recommendation implementation status.
   9. Corrective actions developed based on the support missions’ recommendations.

**The primary support resources**

* **Budgetary resource:** Regular interaction between the WANO-MC personnel and the member station/utility personnel. The number of WANO activities corresponds to the achieved interaction and support level but should be no less than one MSM/workshop per year; the number of benchmarking missions is not limited.
* **Additional resource:** WANO activities in excess of the budget-based resource.
* **Administrative resource:** Interaction of the WANO-MC or WANO executives (including the WANO CEO and WANO Chairman) with the member station/utility executives in various formats such as visits, conferences, negotiations, correspondence, etc., to ensure improved performance, fulfilment of the WANO membership obligations and address identified gaps.

**Interaction and support levels**

Based on the achieved interaction and support levels, the following categories of support resources are possible:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Level**  **Resource** | A | B | C | D | E |
| Budgetary | x | x | x | x | x |
| Additional |  |  | x | x | x |
| Administrative | (x) | (x) | (x) | x | x |

х - Mandatory provision of resource

(х) - Optional provision of resource.

**Based on the date per the criteria, the following potential interaction and support levels are to be considered for a member station/utility:**

**A**: Limits 2 and 3 for any of the criteria have not been reached, and the member station/utility provides support to other WANO-MC member stations/utilities by hosting benchmarking visits, providing experts to take part in WANO-MC activities at the request of the WANO-MC office, and providing information on the existing strengths and good practices.

**B**: Limits 2 and 3 for any of the criteria have not been reached.

**C**: Limit 2 has been reached for any one or two criteria, and Limit 3 has not been reached for any of the criteria.

**D**: Limit 3 has been reached for one or more criteria in the “Operational performance” section, or Limit 2 has been reached for four or more criteria.

**Е**: The station/utility was at Level D in the previous year and there is no improvement in the problem areas.

Level C of potential interaction and support is to be considered for stations/utilities that meet the following additional conditions (if there no conditions to consider Level D in other criteria):

* the station is about to start a new unit, or re-start an existing unit after a prolonged shutdown
* an older unit on the site is preparing for a large-scale upgrade, life-time extension or power uprate
* a unit on the site is in the decommissioning stage and nuclear fuel has been staying in the unit for three years
* a unit on the site contains nuclear fuel and has been in shutdown for longer than six months
* the station/utility is undergoing large-scale organisational changes that have an impact on the distribution of duties and responsibilities for nuclear safety (e.g. a change in the ownership or other changes than may have an impact on the distribution of duties and responsibilities for nuclear safety)
* the station remains first-of-its-kind in the utility’s fleet until positive follow-up peer review results are achieved
* the station/utility has communication problems (additional support within the administrative resource)
* difficulties exist as regards the access of experts to the station/utility or providing experts from the station/utility to take part in WANO activities (additional support within the administrative resource)

**Assessment of the Bushehr NPP status per the WANO criteria**

| **Criteria \ Limits** | **Limit 1** | **Limit 2** | **Limit 3** | **Description of the status per the criteria** | **Actual limit** |
| --- | --- | --- | --- | --- | --- |
| 1. **Fulfilment of WANO Membership obligations** | | | |  |  |
| * 1. Hosting WANO peer reviews | * compliance with the prescribed frequency of WANO peer reviews or equivalent reviews | * non-compliance with the prescribed frequency of WANO peer reviews or equivalent reviews for over one year | * non-compliance with the prescribed frequency of WANO peer reviews or equivalent reviews for over two years | 1st PR Follow-Up in 2017  2nd PR DIR was held in 2019  PR Follow-Up will be on October 2021 | **Fulfilled**  **Limit 1** |
| * 1. Submitting event reports to WANO [[1]](#footnote-1) | * reports to WANO on all “Significant” or “Noteworthy” events have been submitted within 140 days after the event occurred [[2]](#footnote-2) | * failure to submit up to three reports to WANO on “Significant” or “Noteworthy” events within 140 days after the event occurred | * failure to submit more than three reports to WANO on “Significant” or “Noteworthy” events within 140 days after the event occurred | In 2020 6 events;  6 report have been submitted  and  In 2021 till now,  2 reports are under process (translating and coding for submitting).  0 out of which were rated as “Significant” or “Noteworthy”. | **Fulfilled**  **Limit 1** |
| * 1. Submitting information on WANO performance indicators | * information on all WANO performance indicators has been submitted | * failure to submit information on all performance indicators for the last year | * failure to submit information on all performance indicators for the last two years | Information is provided to calculate the WANO PIs established for a particular unit.  Plant submits information about PI quarterly. | **Fulfilled**  **Limit 1** |
| * 1. Providing experts to fill in WANO vacancies at WANO’s requests | * no less than one expert per unit has been provided to participate in WANO activities and programmes outside the station over the last year | * less than one expert per unit has been provided to participate in WANO activities and programmes outside the station over the last year | * failure to provide experts to participate in WANO activities and programmes outside the station over the last year | no less than one expert per unit has been provided to participate in WANO activities and programmes outside the station over the 2020 year.  In 2020, = 17  In 2021 till now, 9 expert involved in WANO **online activities** and programmes outside the NPP. | **Fulfilled**  **Limit 1** |
| * 1. Providing experts to fill in WANO vacancies at WANO’s requests | * experts to fill in WANO vacancies have been provided over the last year | * failure to provide experts to fill in WANO vacancies at WANO request over the last year | * failure to provide experts to fill in WANO vacancies at WANO request over the last two years | NPP provided expert to work in WANO vacancies:  Hamid Azarbad. – WANO-MC Representative  Sirous Shirzadi. – WANO-MC advisor (in the office) | **Fulfilled**  **Limit 1** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1. **Operational performance** | | | |  |  |
| * 1. WANO Assessments result (the criterion is used after the peer review and until the results of the follow-up peer review are obtained): | * 1 or 2 | * 3 | * 4 or 5   or   * 3 second time successively   or   * deterioration of the score by 2 or more | Second WANO PR DIR was held in the 4Q 2019 year and identified 7 AFI.  WANO Assessment = (2) | **Fulfilled**  **Limit 1** |
| * 1. Status of AFIs from previous peer reviews identified by the follow-up peer review (the criterion is used after the follow-up review till the following peer review): | * level A or B[[3]](#footnote-3) for nuclear-safety-significant AFIs[[4]](#footnote-4)   and  level A or B for all Safety Culture AFIs  and   * level A or B for at least 80% of all AFIs | * level C for no more than one nuclear-safely-significant AFI   or   * level C for no more than one Safety Culture AFI   or   * level C for more than 20% of all AFIs | * level C for two and more nuclear-safely-significant AFs   or   * level C for two and more Safety Culture AFIs   or   * level D for any AFI | In the current period (between PR and Follow-Up) this criteria should not be used. | **This criteria should not be used.** |
| * 1. Achieving long-term goals[[5]](#footnote-5) for key WANO performance indicators[[6]](#footnote-6) for the previous calendar year calculated [[7]](#footnote-7) as follows: К = number of indicators that have not achieved long-term goals [[8]](#footnote-8) / number of units | * К≤1 | * 1<К<3 | * К≥3 | There are key performance indicators for which the long-term goals have not been reached in the previous year, then calculate the K factor:  (US7=2.09)  (FLR=5.35) | **Fulfilled**  **Limit 2** |
| * 1. Decline of key indicators during at least two quarters successively, calculated by the formula: K = number of indicators that have declined/ number of units | * К≤1 | * 1<К<3 | * К≥3 | There are key performance indicators that decline for no less than two quarters successively, then calculate the K factor:  (FLR:20Q3=5.22;20Q4=5.35)  (US7:20Q3=2.03;20Q4=2.09) | **Fulfilled**  **Limit 2** |
| * 1. Occurrence of “Significant” or “Noteworthy” events that reveal major issues at the station. | * no “Significant” or “Noteworthy” events[[9]](#footnote-9) | * Significant” or “Noteworthy” events have occurred | * Significant” or “Noteworthy” events have occurred related to excessive radiation exposure or severe personnel injury | None | **Fulfilled**  **Limit 1** |
| * 1. Development of corrective actions addressing AFIs after the peer review | * developed within three months after the peer review | * developed within a period over three months | * not developed | corrective actions program (CAP) addressing AFIs after PR 2019 developed within the required time period (2 months) and was sent to MC officially. | **Fulfilled**  **Limit 1** |
| * 1. Member Support Missions (MSMs) for AFIs mentioned in the Executive Summary of the peer review report | * MSMs for AFIs mentioned in the Executive Summary of the peer review report are hosted per the Interaction Plan and the achieved interaction level[[10]](#footnote-10) | * the hosting of MSMs for AFIs mentioned in the Executive Summary of the peer review report does not comply with the Interaction Plan and the achieved interaction level | * the hosting of MSMs for AFIs mentioned in the Executive Summary of the peer review report does not comply with the Interaction Plan and the achieved interaction level for more than two years successively | 6 MSM held for AFIs, addressed in “Summary” of PR Report within the 2016, 6 MSM on 2017, 2 MSM on 2018 and 3 MSM for 2019.  6 MSM for 2020-21 planed based on AFIs but Plan for 2020 was postponed to 2021-22 | **Fulfilled**  **Limit 1** |
| * 1. Status of SOER recommendation implementation per the results of the last peer review or follow-up peer review: | * less than 10% of the reviewed SOER recommendations are assessed as “Awaiting Implementation” based on WANO peer review results | * 10–25% of the reviewed SOER recommendations are assessed as “Awaiting Implementation” based on WANO peer review results | * more than 25% of the reviewed SOER recommendations are assessed as “Awaiting Implementation” based on WANO peer review results | Less than 4% of the reviewed SOER recommendations have status “Further actions required”, based on WANO review results on 2019. | **Fulfilled**  **Limit 1** |
| * 1. Development of corrective actions addressing MSM recommendations: | * the corrective action plan for MSM recommendations has been developed on time[[11]](#footnote-11) and the corrective actions are being implemented as planned | * the corrective action plan for MSM recommendations has not been developed on time and the corrective actions have not been implemented within the specified time frames | * no corrective action plan for MSM recommendations has been developed | MSM corrective actions plan for each MSM is developed and the activities either implemented or on track within the determined time period that are performed within deadlines. | **Fulfilled**  **Limit 1** |

The results of the assessment of the XXX NPP/utility status per the WANO criteria:

|  |  |  |  |
| --- | --- | --- | --- |
| **Group of criteria \ Limit** | **Limit 1** | **Limit 2** | **Limit 3** |
| 1. Fulfilment of WANO Membership obligations | 5 | 0 | 0 |
| 1. Operational Performance | 6 | 2 | 0 |

Additional conditions to categorize the BUSHEHR plant / utility as “**C**” (if there are no conditions to categorize it as “**D**” per other criteria): None (otherwise, indicate the additional conditions) No \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Recommendations as to use the administrative resource (if the total of limits for all the criteria in Section 1 is greater than >5) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ No

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Expected interaction category \_\_\_\_\_\_\_\_**\_B\_\_**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Information package for the preparation of the WANO-MC Expert-Analytical Group meeting for the Bushehr NPP.**

**as of May 2021**

**Contens**

[**1. Performance indicators (PI) section** 14](#_Toc39238129)

[**2. Power histories for the last 2 years** 15](#_Toc39238130)

[**3. Operating Experience (OE) section** 18](#_Toc39238131)

[**4. (Pre-start-up) Peer review results.** 20](#_Toc39238132)

[**5. Follow-up peer review results** 23](#_Toc39238133)

[**6. SOER recommendations implementation status** 23](#_Toc39238134)

[**8. WANO Representative analysis** 27](#_Toc39238135)

**APPROVED BY:**

**(Plant Director)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_ Reza Banazadeh**

**DEVELOPED BY:**

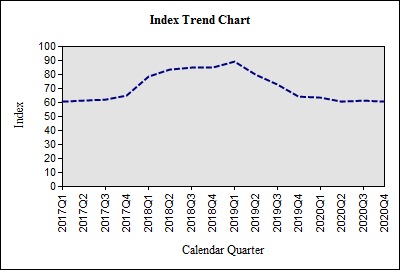
**(WANO-MC site representative)**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Hamid Azarbad**

**1. Performance indicators (PI) section**

*WANO Index Trends for the Bushehr NPP from the 1st quarter of 2016 to the 4th quarter of 2019.*

Oversight of the WANO Index and WANO PIs*.*

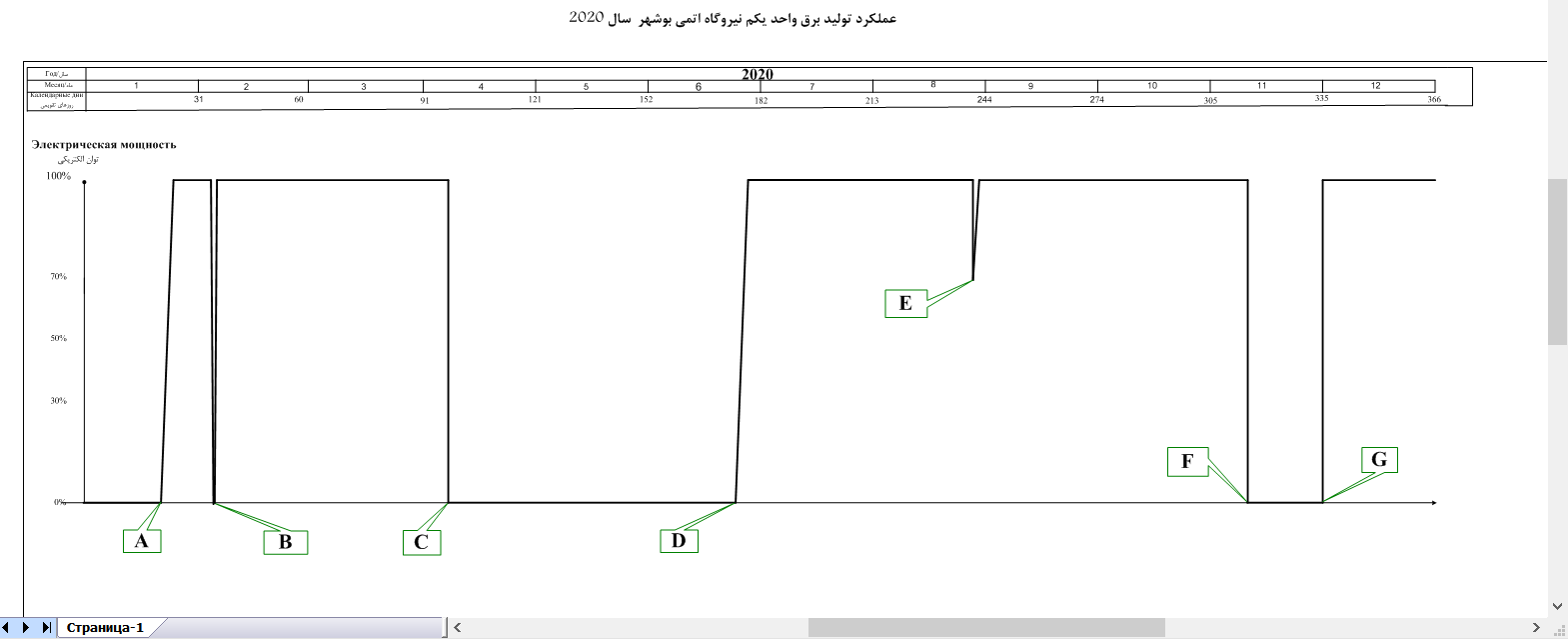


|  |  |  |
| --- | --- | --- |
|  | **Index Table  PI Index (Method 4)** |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Unit:** Bushehr 1 | | | | | |
| **Reactor Type:** PWR | | | | |  |
| **Index Period:** 2020Q4 | | | | |  |
| **Report Generation Date:** 15 April, 2021 | | | | |  |
| **Indicator** | **Period** | **Max Points** | **Indicator Value** | **Actual Points Achieved** | **Last Quarter** |
| CRE | 24 | 10 | 23.84 | 10.0 | 10.0 |
| CY | 24 | 5 | 1.00 | 5.0 | 5.0 |
| FLR | 24 | 15 | 7.57 | 0.9 | 1.5 |
| FRI | 12 | 10 | 1.00E-06 | 10.0 | 10.0 |
| ISA2 | 24 | 5 | 0.00 | 5.0 | 5.0 |
| SP1 | 36 | 10 | 0.0000 | 10.0 | 10.0 |
| SP2 | 36 | 10 | 0.0000 | 10.0 | 10.0 |
| SP5 | 36 | 10 | 0.0000 | 10.0 | 10.0 |
| UA7 | 24 | 10 | 1.59 | 0.0 | 0.0 |
| UCF | 24 | 15 | 72.66 | 0.0 | 0.0 |
| **Total Weighted Points** |  | **100** |  | **60.9** | **61.5** |
| **Total Normalized Points** |  |  |  | **60.9** | **61.5** |

**2. Power histories for the last 2 years**

*(Provide your*Electricity output diagram for Bushehr NPP unit 1 for 2 last fuel cycles:

Power Production Performance of 7th Fuel Cycle of Bushehr NPP on 1398-99(2020):

**АЭС Бушер в 2020 году**

Bushehr NPP-1 Power Generation Performance - 2020

A- On 09.01.2020 at 09:00 after the repair of bearing No.1 of the turbine, the Unit was connected to the national grid.

B- On 04.02.2020 at 06:12, closure of stop valves of the turbine and disconnection of generator from the grid due to decrease of oil pressure of the turbine control line, and on 05.02.2020 at 04:20 the Unit was connected to the national grid.

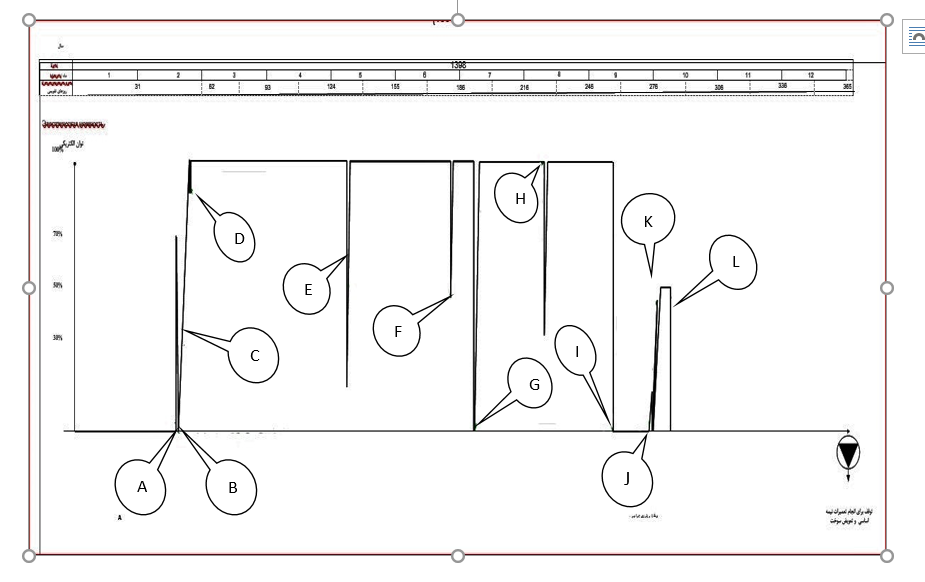
C- On 12.04.2020 at 21:47, shutdown of the Unit for refueling Outage.

D- On 21.06.2020 at 14:07, connecting the Unit to the national grid after refueling and performing repairs

E- On 27.08.2020 at 21:16, Decrease of Unit power to 70% of the nominal power due to increase of temperature of turbine oil and loss of power of bus bar 10BF and shutdown of chillers. On 28.08.2020 at 04:00, the Unit reached 100% of its nominal power.

F- On 09.11.2020 at 02:28, shutdown of the Unit for removing the defect of water leak from the flange YP23S003.

G- On 01.12.2020 at 01:46, connecting the Unit to the national grid after removing the defect.

Power Production Performance of 6th Fuel Cycle of Bushehr NPP on 1398(2019-2020) :

**АЭС Бушер в 2019-2020 году**

1. On 29 April 2019 at 23:00, Bushehr NPP was connected to the Grid after mid-life repairs.

D

K

L

I

H

G

1. On 1 May 2019 at 17:26 power was reduced due to shutdown of feed water pump RL22D001 and actuation of reactor emergency protection due to SG level reduction to less than 65mm while the RCPs were on
2. On 3 May 2019 at 03:02 the generator was connected to the Grid after the approval of National Grid Dispatching.
3. In 4 May 2019 at 12: 07 reduction of reactor power by pressure rise in main steam collector due to TCM (Turbine Control Mechanism) system (mechanism for directing and controlling the turbine) being removed from automatic mode. Power began increasing at 12:25.
4. Power reduction to 19% on 06.05.98 due to the error signal of leakage from primary to secondary circuit and opening of БPY-A (BRU-A) and reaching 100% of nominal power on 20 July 2019 at 12:00.
5. On 18 December 2019at 06:00 shutdown of RL12 and backup pump not starting and reduction of power to 50% of nominal power and reaching 100% of nominal power at 1:30 on 20 September
6. On 27 September 2019 at 18:00 due to disconnection from the Grid by the SG No. 3 level reduction and actuation of emergency protection of reactor by error signal of SG NO. 4. the Unit was connected to national grid at 3:00 on 29 September 2019
7. On 1 November 2019 at 7:00 due to the request of National Grid Dispatching for getting connected to Iraq Grid, power reduced to 37% of nominal power and on 2 November at 19:00 it reached 100% of nominal power.
8. On 3 December 2019 at 21:40 the disconnection of generator from National Grid due to error in generator exciter system.
9. On 21 December 2019 at 17:00, the Unit was connected to National Grid. At 19:00 on the same date, the Unit was disconnected from the Grid when it was operating with the power of 107 MW.
10. On 22 December 2019 at 01:00 the Unit was connected to national Grid. On the same date at 15:00 the Unit was disconnected form the Grid when it was operating with the power of 48 MW.
11. On 23 December 2019 at 09:00 the Unit was connected to National Grid. On 27 December 2019 at 11:00 it was disconnected from the National Grid when it was operating with the power of 13 MW.

**3. Operating Experience (OE) section**

*Provide information on the event reports sent to WANO*

| **Year** | **Unit 1** | **Total** |
| --- | --- | --- |
| **2018** | 6 | 6 |
| **2019** | 7 | 7 |
| **2020** | 6 | 6 |
| **2021** | 2 | 2 |
| **Итого:** | 21 | 21 |

**2017:**

1- WER MOW 2017-236,  Fire on the normal operating Busbar10CC , Пожар на секции нормального питания 10CC [(АЭС Бушер 1, 02 апреля 2017г.)](https://www.wanomc.ru/Secure/Programm/OE/WER/2017/index.php?print=Y" \l "69104340586851)

2- WER MOW 2017-242, Earthquake of 970 Km far distance from BNPP with a magnitude 7.4 Richter , Землетрясение на расстоянии 670км от станции уровнем 7,4 балла по шкале Рихтера.(АЭС Бушер 1, 12 ноября 2017г.)

3- WER MOW 2017-274, Primary circuit main pump (RCP) No.4 tripped , Отключение ГЦН 4 (АЭС Бушер 1, 24 апреля 2017г.

4- WER MOW 2017-275, Decrease of the Unit’s power to 53% of the nominal power level after a trip of primary circuit main pump No.2 , Снижение мощности реактора до 53% из-за отключения ГЦН 2 (АЭС Бушер 1, 25 сентября 2017г.)

5- WER MOW 2017-276 , 12 % decrease of the Unit power from the nominal power due to trip of two working pumps of the RG system (Moisture separator drains system) Снижение мощности блока на 12% от номинальной из-за отключения двух работающих насосов дренажной системы сепаратора (АЭС Бушер 1, 17 мая 2017г.)

6- WER MOW 2017-277 , Power decrease to 800 MW due to a trip of circulating pump of VC system (main cooling water system) , Снижение мощности блока до 800 МВт из-за отключения циркуляционного насоса основной системы охлаждающей воды (АЭС Бушер 1, 18 сентября 2017г.)

**2018:**

1- WER MOW 2018-0156, Unexpected actuation of reactor emergency protection at the time of reactor power decrease.

2- WER MOW 2018-0243, Reactor power decrease due to drop one of control rods.

3- WER MOW 2018-0244 , Automatic unplanned shutdown of a main reactor cooling pump due to increase of water level of the related steam generator.

4- WER MOW 2018-0288, Damage to the surfaces of Graphite Segments and components of Axial-Radial Bearing of the reactor cooling pump (RCP) No.3.

5- WER MOW 18-0289 , Reactor power reduction to 82% of nominal power during work regime change of working oil pump of turbine control system to the backup pump.

6-WER MOW 18-0352, A manual srcam of the reactor by operator because of losing all the main feed water pumps by actuation of the protection “ decrese of the outlet pressure of the pumps of intermediate cooling system(VH)”

**2019:**

1-WER MOW 19-0041 , A main safety valve of the primary circuit pressurizer opened due to formation of a wrong signal. (29.07.2018).

2- WER MOW 19-0048 , Unit power reduction due to a circulation pump trip. [(30.09.2018)](https://www.wanomc.ru/s_secure/Programm/OE/WER/2019/WER%20MOW%202019-0048.docx).

3- WER MOW 19-0052 , The unit power was reduced due to the oil temperature increasing of the turbine lubrication system. [(09.10.2018)](https://www.wanomc.ru/s_secure/Programm/OE/WER/2019/WER%20MOW%202019-0052.docx).

4- WER MOW 2019-0171 Unit disconnection from the national power grid. (02.02.2019).

5- WER MOW 2019-0208 Emergency reactor shutdown via the push of the emergency protection button (EP) due to the loss of all pumps of the main water pumps of steam generators at a unit power over of 25% nominal. ([26.02.2019)](https://www.wanomc.ru/s_secure/Programm/OE/WER/2019/WER%20MOW%202019-0208.docx).

6- WER MOW 2019-0283 reducing the power of the unit to 85% nominal due to the fact that the operator did not pay attention to the change in the mode of operation of the turbine control system from automatic to manual.[(04.05.2019)](https://www.wanomc.ru/s_secure/Programm/OE/WER/2019/WER%20MOW%202019-0283.docx).

7- WER MOW 2019-0398 False signaling leak from the first circuit in the second in SG-1 led to a reduction in reactor power.( [28.07.2019)](https://www.wanomc.ru/s_secure/Programm/OE/WER/2019/WER%20MOW%202019-0398.docx).

**2020:**

1- WER MOW 2020-0107 Actuation of reactor protection system (EP) due to false signal "Low level level decrease in steam generator No. SG-4" [( 27.09.2019) (27/09/2019)](https://www.wanomc.ru/s_secure/Programm/OE/WER/2020/WER%20MOW%202020-0107.docx).

2- WER MOW 20-0146 Reactor protection actuation at the reactor minimum control power level ( 04/12/2019).

**3-** [WER MOW 20-0173](http://www.wano.org/OperatingExperience/OE_Database_2012/Pages/EventReportDetail.aspx?ids=38051) A spurious alarm signal of the generator excitation protection system tripped the generator from the grid (03/12/2019).

4- [WER MOW 20-0205](http://www.wano.org/OperatingExperience/OE_Database_2012/Pages/EventReportDetail.aspx?ids=38222) Actuation of the reactor Accelerated Preventive Protection (APP) due to pipe rupture and oil pressure drop in the Turbine Governing System (SJ). (04/02/2020)

5- [WER MOW 20-0215](http://www.wano.org/OperatingExperience/OE_Database_2012/Pages/EventReportDetail.aspx?ids=38249) Power decrease more than 25% nominal by Actuation of Reactor Accelerated Preventive Protection (APP) due to shutdown a Main Feedwater Pump (18/09/2019).

6- [WER MOW 20-0282](http://www.wano.org/OperatingExperience/OE_Database_2012/Pages/EventReportDetail.aspx?ids=38954) Unit turbogenerator electrical power decreased by 9.5% due to partial closure of fast acting main steam isolation valve (26/03/2020).

**4. Peer review results.**

*Summary of the AFIs identified during the last peer review indicating the most significant AFIs, continuing and repeated AFIs, as well as strengths. Information about ` peer review (if available)*

In the period of 19 November to 04 December 2019, (PR: 19.11-05.12.2019 + CPO: 08.11-19.11.2019), Moscow Center conducted a peer review of Bushehr Nuclear Power Plant.

The plant performance was reviewed in 2 fundamentals, 6 functional and 10 production areas. In this PR the Crew Performance Observations(CPO) were carried out at the full-scale simulator in the period from 08 to 20 November 2019 and for this purpose, the PR team included two experts and a CPO leader.

A preliminary visit to the plant took place from 11 to 17 June 2019. During the preliminary visit, the WANO team conducted observations of outage activities, emergency drills and the MCR crew training at a full-scope simulator. In addition, the team conducted Crew Performance Observations at the full-scope simulator.

The Peer Review was conducted following the Design-Informed Peer Review (DIPR) methodology. This means that the facts and areas for improvement were weighted in terms of their significance for the fulfilment of the design-basis safety functions.

The WANO team has acknowledged that overall, the Bushehr NPP is maintained in a good condition; the production activities are quite effective in many areas and have shown significant improvement in recent years. The integrated indicator ‘WANO Index’ has grown from 60% to 80% in the last three years.

The PR team identified:

* 5 strengths, (MA.1-1, MA.2-1, CY.1-1, RP.1-1, OR.4-1, HU.1-1).
* 7 areas for improvement (AFIs); OP.1-1, RP.1-1, OF.1-1, PI.2-1, OR.3-1, HU.1-1, EP.2-1).

out of these there were: 1 Repeated AFI (PI.2-1).

**Strengths (Good Practices)**

Merits of the plant performance are reflected in the following strengths identified by the Peer Review team:

* **MA.1-1** – A tool coding system has been introduced at the station to track handling of the work tools, rigging and accessories (type 2)
* **MA.2-1** – The station actively practices video recording of the work processes to raise training effectiveness and gain experience in the conduct of challenging and rarely performed activities (type 2)
* **CY.1-1** – Chemistry personnel use portable laboratory instruments to measure oxygen and hydrogen concentrations in the primary coolant (type 2)
* **RP.1-1** – The station uses a touch monitor to display the radiological data for premises in the radiological control area (type 2)
* **OR.4-1** – Video tutorials presenting management standards are shown at manager meetings to enhance senior management professionalism (type 1)
* **HU.1-1** – Safety plates are placed on the tile control panels in order to preclude inadvertent mistakes of the MCR (ECR) personnel and prevent unauthorized control of valves and machinery (type 2)

**Areas for improvement**

The Peer Review team has identified seven Areas for Improvement (AFI). One of them repeats the AFI from the PR conducted in 2015. Three AFIs have been qualified as particularly significant for the plant safety and reliability, though the rest also demand intense attention:

1. **OP.1-1** The MCR crew did not always effectively diagnose/monitor equipment condition and used procedures to make correct operational decisions in the abnormal and accident conditions simulated at the full-scope simulator

2. **OF.1-1** The plant personnel do not always effectively monitor the in-service condition of the equipment to identify and resolve operational problems

3. **OR.3-1** Risk assessment methods and procedures are not always systematically used in the decision-making process to control collective risk

4. **HU.1-1** Operations and technical administrative managers do not always promote the environment conducive to minimizing the likelihood of human errors during lineup activities

5. **PI.2-1** The root causes are not always identified in the event investigation, or are identified out-of-time

6. **RP.1-1** Practices and procedures of radiological monitoring used by the personnel do not fully provide for reliable surveillance of radiological situation and for prevention of spread of contamination

7. **EP.1-1** The plant has not fully implemented the Severe Accident Management (SAM) arrangements

Notes: The PR team detected 7 areas for improvement. AFIs vary in scope and significance, and they would require different efforts to improve the current situation. The most important areas are the following 3 areas: PI.2-1, EP.2-1, OR.3-1.

The repeated and important AFI PI.2-1 is associated with non-technical problems, human errors and weaknesses in the area of administration and leadership. It is necessary to note that the operational experience accounting system does not effectively collects and analyzes the plant information, and does not further supports the plant leadership actions in assessing the organization’s; performance. Detection of performance weaknesses, their significance assessment, and support to the leaders in making the decisions on the corrective measures and improving the performance indicators are not always efficient.

**List of repeated or continuing AFIs:**

**Repeated AFI: AFI PI.2-1**

**PI.2-1:** The root causes are not always identified in the event investigation, or are identified out-of-time.

**Progress on information of the AFIs according to WANO representative:**

Based on the results of WANO PR and for improving the level of areas developed the corrective actions program for each area or the all above AFIs as “Plan of Corrective actions” and have been introduced by Station Order No. LTR-1000-244471 dated Feb 16, 2020. This Plan Was Sent to WANO MC by letter no. LTR-1000-248176 with Bushehr NPP program of CM, on April 28, 2020.

Additional corrective measures for EP area have been prepared and developed and all the measures are under control and monitoring. NPP Self-assessments and assessments by OSR based on WANO documents are planned to be implemented at Bushehr NPP based on the order from NPP director. For all these 7 areas planned self-assessment by NPP counterparts and WANO OSR, and at the same time will be implemented the targeted observations by WANO-MC OSR according to the scheduled plan. All results of implemented targeted observations will be reviewed on the meetings with NPP managers and NPP CE with participation of WANO MC OSR.

According to the review and assessments of current status of Areas For Improvement the WANO-MC OSR collected and presented relevant notes. Plant managers overviewed these deficiencies and already managed under control and the plant management maintain coordination and control of the efforts aimed at improvements in these areas.

**5. Follow-up peer review results**

*Summary of the results of the last follow-up peer review (if it was conducted after the last peer review) with the AFIs’ ratings.*

WANO Peer Review was held on 2019. The Follow-Up will be conducted on October 2021.

**6. SOER recommendations implementation status**

*Provide a summary of the SOER recommendations implementation status as assessed during the last peer review (follow-up peer review) – number of recommendations assessed as FAR, AI, SAT. Brief description of the SOER recommendations implementation status as assessed by station self-assessment and targeted observations by the WANO-MC Representative, including implementation of planned activities.*

The last independent assessment of SOER recommendations implementation was performed during WANO PR 2019. During WANO PRs, 239 recommendations included in the 17 SOERs have been reviewed. Out of 17 SOERs, the peer review teams have reviewed 17, implementation of the recommendations of all active SOERs have been reviewed that the total amount of implemented (completed) recommendations is 239.

**Assessment of implementation of the SOER recommendations:**

Out of 17 reviewed SOERs (1998-1, 1999-1, 2001-1, 2002-1, 2002-2, 2003-1; 2003-2, 2004-1, 2007-1, 2007-2, 2008-1, 2010-1, 2011-1, 2011-3, 2013-1…) the Peer Review looked at **72** outstanding recommendations made in 17 ‘Significant Operating Experience Reports’ (SOER). Fifty-two **(52)** reviewed recommendations were rated as ‘Satisfactorily implemented’ (SAT), **17** got the status of ‘Attention to implementation needed’ (AI), and **3** were qualified as ‘Further action required’ (FAR).

SOER reports with ‘FAR’ recommendations:

– SOER 1999-1 ‘Loss of grid’ (5d)

– SOER 2007-1 Rev.1 ‘Reactivity management’ (1b)

– SOER 2010-1 ‘Shutdown safety’ (12a)

Significant progress has been made in the implementation of the SOER recommendations, although the station overestimated the status of recommendation implementation in its pre-PR self-assessment. The recommendations that the WANO team has rated as ‘FAR’ point to the necessity of improving the operational personnel behavior and response to reactivity variations, as well as to the need to broaden emergency management training for Unit shutdown conditions and for severe accidents.

|  |  |  |  |
| --- | --- | --- | --- |
| No. | SOER recommendation | Status by WANO review | Status by WANO Representative’s assessment |
| 1 | 2 | 4 | 5 |
|  | 1998-1  Safety System Status Control | SAT– 6 |  |
| 0 |  |
| 0 |  |
|  |  |
|  | 1999-1 with the 2004 Addendum.  LOSS OF GRID | SAT– 19 |  |
| AI -1 |  |
| FAR -1 |  |
|  |  |
|  | 2001-1  Unplanned Radiation Exposure | SAT– 12 |  |
| AI -1 |  |
| 0 |  |
|  |  |
|  | 2002-1 Rev.1  Severe Weather | SAT– 5 |  |
| AI -1 |  |
| 0 |  |
|  |  |
|  | 2002-2  Emergency Power Reliability | SAT–9 |  |
| 0 |  |
| 0 |  |
|  |  |
|  | 2003-2 Rev.1  Reactor Pressure Vessel Head Degradation at Davis-Besse | SAT– 10 |  |
| 0 |  |
| 0 |  |
|  |  |
|  | 2004-1  Managing Core Design Changes | SAT– 4 |  |
| AI -1 |  |
| 0 |  |
|  |  |
|  | 2007-1 Rev.1  Reactivity Management | SAT– 25 |  |
| 0 |  |
| FAR -1 |  |
|  |  |
|  | 2007-2  Intake Cooling Water Blockage | SAT– 13 |  |
| 0 |  |
| 0 |  |
|  |  |
|  | 2008-1  Грузоподъемные приспособления, подъем и перемещение грузов | SAT– 20 |  |
| 0 |  |
| 0 |  |
| NP - 0 |  |
|  | 2010-1  Shutdown Safety | SAT– 21 |  |
| 0 |  |
| FAR -1 |  |
|  |  |
|  | 2011-1 Rev.1  Large Power Transformer Reliability | SAT–23 |  |
| 0 |  |
| 0 |  |
| 0 |  |
|  | 2011-3 Rev.1  Fukushima Daiichi Nuclear Station Spent Fuel Pool/Pond  Loss of Cooling and Makeup | SAT– 5 |  |
| AI -1 |  |
| 0 |  |
| NP – 1 |  |
|  | 2013-1  Operator Fundamentals Weaknesses | SAT– 9 |  |
| AI -3 |  |
| 0 |  |
| 0 |  |
|  | 2013-2  Post-Fukushima Daiichi Nuclear Accident Lessons Learned | SAT– 30 |  |
| AI – 2 |  |
| FAR -0 |  |
| NP –1 |  |
| NR – 0 |  |
|  | 2015-1 Rev.1  Safety Challenges from Open Phase Events | SAT– 5 |  |
| AI - 1 |  |
| FAR - 0 |  |
| NP - 0 |  |
|  | 2015-2  Risk Management Challenges | SAT– 1 |  |
| AI - 6 |  |
| FAR - 0 |  |
| NP - 0 |  |
| No. | SOER recommendation | Status by WANO’s review | Status by WANO Representative’s assessment |

Results of assessment: The numbers of the recommendations reviewed by WANO MC PR Team are 239 in which:

|  |  |  |
| --- | --- | --- |
| SAT | Satisfactorily Implemented | **217 (%90)** |
| AI | Awaiting Implementation | **17 (%7)** |
| FAR | Further Action Required | **3 (%2)** |
| NP | Not Relevant to the plant | **2 (%1)** |
| NR | Not Reviewed by the PR Team | **0 (%0)** |

**Current SOER recommendations status:**

There is no assessment by WANO MC representative because the PR was conducted recently on the end 0f 2019 and the corrective actions program of the remaining recommendations of SOER reports which had not been assessed as satisfactorily implemented during WANO-2019 peer review will be done in this year and Assessment will be planned on the next quarters together with the relevant divisions and managements and WANO MC OSR.

**7. MSM results**

*Summary (statistics) of the planned and completed MSMs (total / MSMs based on AFIs) in the reporting period (e.g. from the last PR). The average rating for the effectiveness of the implemented implementation.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **MSM Title** | **Dates** | **Date of completion of the last corrective action** | **Assessment of effectiveness** | | |
| 1. Self assessment  (AFI – PI) | February 26- March 02, 2016 | April 2018 | Customer | F-up PR | WANO-MC Representative |
| 3.84 |  | 3.84 |
| 2. Configuration management. Temporary and permanent modification  Engineering support (CM.3-1) | 06-09 February 2016 | May 2018 | Customer | F-up PR | WANO-MC Representative |
| 4 |  | 4 |
| 3. The system performance of the equipment and the assessment of its condition.  EN.1-1 | 27-29 Feb 2016 | March 2017 | Customer | F-up PR | WANO-MC Representative |
| 3.5 |  | 3.5 |
| 4. The adoption of effective operational decision making  LF.1-1 | 23-26 April, 2016 | 2018 | Customer | F-up PR | WANO-MC Representative |
| 3 |  | 2 |
| 1. Methods for eliminating the human error - Supervision on personnel performance  AFI base (HU.1) | 20 – 25 October 2017 | Feb. 2019 | Customer | F-up PR | WANO-MC Representative |
| 3.68 |  | 3.68 |
| 2. Radiation control and prevent the spread of contamination and minimize Radwaste volumes.  AFI base (RP.3-1 and RP.4-1) | 07 -11 August 2017 | 2019 | Customer | F-up PR | WANO-MC Representative |
| BM |  | BM |
| 3. Procedure for justification of application of TVS-2M in WWER-1000 nuclear power plant ", | 01-05 July 2017 | 2021 | Customer | F-up PR | WANO-MC Representative |
| 3.66 |  | 3.66 |
| 1. Sever accident management system  AFI base (EP-2-1) | 08-11 December 2018 | 2020 | Customer | F-up PR | WANO-MC Representative |
| 3.5 |  | 3.7 |
| 2. BM Visit - Systems and requirements of the crisis management centers, emergency preparedness of NPPs. (EP-2-1) | 6-13 May 2018 | 2019 | Customer | F-up PR | WANO-MC Representative |
| BM |  | BM |
| 1. The manner of conducting nuclear safety status assessment in a NPP | 6-12 July 2019 | 2020 | Customer | F-up PR | WANO-MC Representative |
| 3.56 |  | 3.56 |
| 2. I&C systems and equipment specifications and their functions and performance during the occurrence of severe accidents.  AFI base (EP-2-1) | 28 Sep – 2 Oct. 2019 | 2020 | Customer | F-up PR | WANO-MC Representative |
| 4 |  | 4 |
| 3. Leadership | 5-9 October 2019 | 2020 | Customer | F-up PR | WANO-MC Representative |
| 3.5 |  | 3.5 |
| Plan will be updated up to the end of April 2021 | 2021-22 | TBD | Customer | F-up PR | WANO-MC Representative |
|  |  |  |

**8. WANO Representative analysis**

*Comments/concerns by the WANO representative of emergent issues that could impact the plant performance. (Comments by the WANO representative of the progress made by the plant.).*

In the overall evaluation of indicators that a score between zero to 100 is belonged to the power plant and is known as Method 4, the indexes and indicators are based on the weight coefficients are cumulative in determining the overall rate of the power plant. In the first season of 2019, the power plant has been equal to 89.57, which shows a good increase of 4.57, compared to the previous season. This has led to the improvement of the rank and position of the Bushehr nuclear power plant, in the manner that, the position of the power plant, which was always in the last quartile, to the second quartile of the Moscow centre power plants for first time. And for the first time after the commercial commissioning of the Bushehr nuclear power plant, three of the UCF, UCLF and FLR indexes from the last quartile have been upgraded to upper quartiles. In relation to chemical indexes of water, the member's industrial accidents and the performance indicators of the safety systems, the indicators are ideal and the optimal area is considered.

From second quarter of 2019, NPP indicators have fulfilled the long term goals of the WANO except some indicators as well as US7, UCF and FLR, meanwhile other indicators and NPP safety at all have acceptable trend.

Negative status and trend of 3 mentioned indicators is due to some reasons. Main cause which has led to fall of performance indicators and subsequently NPP index in 2019 has been in the production indicators. Annual repairs and refueling beginning from 26 February and lasting for 63 days led to the fall of Unit Capability Factor. This reduction of indicator aggravated from September, 3 and as a result of failure in bearing No. 1 of the turbine. This led to the rise of Unplanned Capability Loss Factor and Forced Loss Rate. On the other hand, increase in the number of actuations of reactor emergency protection system (One manual in Feb, 2019 and three automatic actuations in May, September and December) has led to rise of indicators US7 and UA7.

These factors together have led to the fall of index and ranking of Bushehr NPP.

Bushehr NPP has made a comprehensive analysis for this issue and had begun and implemented compensatory and corrective actions in order to improve the trend of indicators.

1. Per the information submittal process established in the respective utility. [↑](#footnote-ref-1)
2. The WANO criteria for the submittal of event reports to WANO and the criteria for the event significance levels are specified in the WANO document MN|01 “Operating experience Sub-Programme. WANO Reference Manual”. [↑](#footnote-ref-2)
3. AFI status is assessed on follow-up peer reviews as specified in the “Guideline for the Conduct of Peer Reviews at WANO-MC”. [↑](#footnote-ref-3)
4. AFIs for which a relationship to nuclear safety is identified. [↑](#footnote-ref-4)
5. Long-term goals are goals set forth in the WANO Long-Term Plan for the WANO key performance indicators. [↑](#footnote-ref-5)
6. Key Performance Indicators are WANO performance indicators for which long-term goals are established, as follows: FLR – Forced Loss Rate, CRE – Collective Radiation Exposure, TISA – Total Industrial Safety Accident Rate, SSPI – Safety System Performance Indicator, US7 – Unplanned Automatic Scrams per 7,000 Hours Critical. [↑](#footnote-ref-6)
7. Indicators are averaged over three years for this criteria. [↑](#footnote-ref-7)
8. The individual performance targets are based on the station key performance indicator values that are better than the 2007 worst quartile values for all stations. [↑](#footnote-ref-8)
9. The event significance criteria are specified in the WANO document MN|01 “Operating experience Sub-Programme. WANO Reference Manual”. Events that occurred due to external causes not related to plant performance are not taken into account. [↑](#footnote-ref-9)
10. The scope of support based on the achieved interaction level is recommended in the document G6.1-2015 “Guidance for Member Support”. [↑](#footnote-ref-10)
11. The time period established for the development and submittal of the corrective action plan is specified as three months in the document G2-2017 “Guidelines for the conduct of MSMs in WANO-MC”. [↑](#footnote-ref-11)