



GENERATION PERFORMANCE STANDARDS CODE

**ELECTRICITY REGULATORY COMMISSION
OF JORDAN**



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GENERATION PERFORMANCE STANDARDS

GLOSSARY AND DEFINITIONS

Any word or expression defined in the General Electricity Law or the Grid Code or the Distribution Code and that is not defined otherwise in this Performance Standards shall have, unless the contrary intention appears, the same meaning and interpretation when used in this Performance Standards, including its Annexes.

When applying the provisions contained in this Performance Standards, and unless otherwise specified or the subject matter or context otherwise requires or is inconsistent therewith, the following words and expressions shall have the following meaning:

- **Actual Unit Starts** means the total number of times the Generation Unit was synchronized during a pre-specified period.
- **Age** means the number of years the Generation Unit has been in commercial service.
- **Annex** means an annex of this Performance Standards.
- **Attempted Unit Starts** means the total number of attempts to synchronize a Generation Unit after being shut down. Repeated failures to start for the same cause, without attempting a corrective action, will be considered a single attempt.
- **Available** means a state of a Generation Unit in which it is capable of providing service, whether or not it is actually in service, regardless of the capacity level that can be provided.
- **Business Day** means any day other than Friday, Saturday or a public holiday in Jordan, when commercial banks are open for business in Jordan.
- **Connection Point** means the point of connection of a Generation Unit or a Power Plant, as applicable to the Transmission or **Distribution System**.
- **Condition** means a condition in this Performance Standards.
- **Derated** means a state of a Generation Unit in which it experience Deratings
- **Derated Hours** means the number of hours a Generation Unit experience Deratings
- **Derating** means a repair or maintenance work, or other action or constraint that causes the reduction of the maximum output capability of a generating unit or group of generating units below the Dependable Capacity (Dependable Maximum Output), but that is not an outage.

- **Distribution System** means a system consisting of cables, overhead lines, electrical **Plant** and apparatus, having a design voltage of 33 kV or lower, used for the distribution of electric power.
- **Electric System** means the system consisting of power stations, the transmission system, the distribution system, and control centres and required equipments for their operation.
- **Energy** means, unless otherwise qualified, active energy.
- **ERC** means the Electricity Sector Regulatory Commission constituted under the General Electricity Law.
- **Failed Unit Starts** means the total number of times a Generation Unit is not capable to synchronize when required by the System Operator.
- **Forced Derated** means a state of a Generation Unit in which a failure or other unplanned condition that requires reducing the output or maximum output immediately or before the end of the next weekend.
- **Forced Outage** means a state of a Generation Unit in which an unplanned component failure (including delayed, postponed or start-up failure) or any other condition requires the unit be removed from service immediately or before the end of the next weekend.
- **Force Majeure** means any circumstance not within the reasonable control of the affected party, but only if and to the extent that (i) such circumstance, despite the exercise of reasonable diligence and observing prudent industry practice, cannot be, or be caused to be, prevented, avoided or removed by such party, and (ii) such circumstance materially and adversely affects the ability of the affected party to comply with its performance obligations under this Performance Standards, and such party has taken all reasonable precautions, due care and reasonable alternative measures in order to avoid the effect of such event on the affected party's ability to perform its obligations under its performance obligations under this Performance Standards and to mitigate the consequences thereof.
- **Force Majeure Outage** means an Outage caused by exceptional and unpredictable events that are not under the affected party control, provided it has taken all possible actions to eliminate or mitigate the problem. In order for an Interruption to be classified as Force Majeure the affected party shall request and the ERC will issue an explicit authorisation to the Generation Licensee.
- **Fully Available** means a state of a Generation Unit in which it is capable of providing its full Net Dependable Capacity, whether or not it is actually in service.
- **General Electricity Law** means the General Electricity Law No. 64 of the Year 2002 or any amendments thereto or any other law that replaces the said law.
- **Generating Unit** means a conversion **apparatus** including auxiliaries and associated equipment, functioning as a single unit, which is used to produce electric energy from some other form of energy.

- **Generation Licensee** means any person licensed to generate electrical energy pursuant to articles 28 and 32 of the General Electricity Law.
- **Individual Performance Indicator** means a Performance Indicator to measure the performance of a single Generation Unit.
- **Maintenance Derated** means a state of a Generation Unit in which the removal of a component for scheduled repairs that can be deferred beyond the end of the next weekend, but requires a capacity reduction before the next Planned Outage.
- **Maintenance Outage** means a state of a Generation Unit in which it is removed from service to perform maintenance works, which is not required immediately and the starting date may be deferred at least one week (up to the next weekend). Typically, Maintenance Outages, when requested, have flexible start dates, and may or may not have predetermined durations.
- **Net Dependable Capacity (NDC) -or Net Dependable Maximum Output-** means NMC modified for seasonal limitations over a specified period of time.
- **Net Maximum Capacity (NMC)** means the greatest capacity at which a Generation Unit can operate continuously under Normal Conditions, deducted the capacity utilized for that unit's station service or auxiliaries, without any undue degradation of operational performance in accordance with Prudent Utility Practice, as informed when the generation was connected to the system and/or its data registered with the System Operator
- **Normal Condition** means the condition at the Connection Point when the system frequency and voltage are within their normal operation limits, and physical and meteorological conditions are as informed when the generation was connected to the system and/or its data registered with the System Operator
- **Overall Performance Indicator** means a Performance Indicator to measure the performance of a Generation Licensee.
- **Outage** means any Planned Outage or Unplanned Outage, including Forced Outages
- **Partially Available (Derated)** means a state of a Generation Unit in which an unplanned component failure or other condition requires the load on the unit be reduced.
- **Performance Indicator** (In the Generation Performance Standards) means a parameter (measured or calculated) that is related to generation availability, Forced Outages or Failed Unit Starts.
- **Performance Standard** means the Generation Performance Standards Code.
- **Planned Derated** means a state of a Generation Unit in which the removal of a component for repair works or maintenance that is scheduled well in advance, has a predetermined duration and that causes a derating, but that does not correspond to an outage of the generation unit.

- **Planned Outage** means a state of a Generation Unit in which is removed from service to do specific works scheduled well in advance and a predetermined start date and duration (e.g., annual maintenance, inspections, testing) has been agreed with the System Operator in advance. Any Maintenance Outage or an extension of a Maintenance Outage qualifies as Planned Outage only if it is requested to the System Operator and approved at least one week in advance.
- **Power Plant** means a set of Generation Units included in the same Generation License.
- **Reserve Shutdown** means a state of a Generation Unit in which it is available for service but not electrically connected to the Transmission System for economic reasons.
- **Size of Derating** (in MW) means the difference between the Dependable Capacity (Dependable Maximum Output) and the Available Capacity (Maximum Output) as a result of a derating reported / declared by the Generator to the System Operator.
- **Transmission System** has the meaning given to it in the **General Electricity Law**.
- **Unavailable** means a state of a Generation Unit in which it is not capable of operation because of the failure of a component, external restriction, testing, work being performed, or some other adverse condition.
- **Unplanned Derated** means a Derated state of a Generation Unit that does not qualify as Planned Derating, including Forced Deratings and deratings caused by extension of maintenance works that were not informed at least one week in advance.
- **Unplanned Outage** means any outage of a Generating Unit that does not qualify as Planned Outage, including Forced Outages and any extension of maintenance works that is not informed at least one week in advance.

PART 2: GENERATION PERFORMANCE STANDARDS

1. SECTION: GENERAL CONDITIONS

1.1. INTRODUCTION AND PURPOSE

1.1.1. This Part of the Performance Standards Code (Generation Performance Standards) establishes the procedures, requirements and indicators for the technical performance of the Licensed Generating Power Plants.

1.2. APPLICABILITY

1.2.1. This Generation Performance Standards applies to the Generation Licensees

1.2.2. This Generation Performance Standards must be applied and used together with the Grid Code or any other codes issued or approved by ERC that applies to any Generation Licensee.

1.3. OBJECTIVES

1.3.1. The objectives of this Generation Performance Standards are:

- (a) To promote high availability of the Generation System;
- (b) To ensure that the Generation Plants will be maintained and operated in a safe and efficient manner and with a high degree of reliability; and
- (c) To ensure the Licensee will submit to ERC all relevant information required to monitor compliance with the issued Generation License

1.4. CONFIDENTIALITY

1.4.1. Unless otherwise specifically stated in this Performance Standards, the ERC shall be at liberty to publish the Performance Indicators, and performance results of the Generation Licensee to whom this Performance Standards applies.

2. SECTION: GENERATION AVAILABILITY

2.1. TYPES OF OUTAGES

2.1.1. Availability of the Generation System will be expressed as a function of the Generation Units Outages, Generation Units Deratings, and will be evaluated using indicators that measure number and duration of these Outages or Deratings.

2.2. GENERATION UNIT STATES AND OUTAGE REGISTER

2.2.1. In each hour (or fraction of hour) the state of the Generation Unit shall be included in one of the following states:

- (a) Fully Available

- (b) Partially Available (Derated)
 - (i) Planned Derated
 - (ii) Unplanned Derated
 - b.ii.1) Maintenance Derated
 - b.ii.2) Forced Derated
- (c) Unavailable
 - (i) Planned Outage
 - (ii) Unplanned Outage
 - c.ii.1) Maintenance Outage
 - c.ii.2) Forced Outage

2.2.2. The Generation Licensee is obliged to have a detailed chronological register of each Generation Unit (Outage Register), detailing all changes in states of the Generation Unit, with clear identification of starting and ending date and time. In the case a Generation Unit is in a Partially Available state, the register shall also include the Size of Derating. The information in this register shall be maintained by the Generation Licensee during at least (5) calendar years.

2.2.3. At the end of each reporting period the Generation Licensee shall use the information contained in the Outage Register to calculate, for each Generation Unit, the following aggregated times:

- (a) Fully Available Hours (FAH): The sum of hours (or fraction of hours) over the reporting period, in which the Generation Unit is in a Fully Available State.
- (b) Planned Derated Hours (PDH): The sum of hours (or fraction of hours) over the reporting period, in which the Generation Unit is in a Planned Derated State.
- (c) Maintenance Derated Hours (MDH): The sum of hours (or fraction of hours) over the reporting period, in which the Generation Unit is in a Maintenance Derated State.
- (d) Forced Derated Hours (FDH): The sum of hours (or fraction of hours) over the reporting period, in which the Generation Unit is in a Forced Derated State.
- (e) Unplanned Derated Hours (UDH) = FDH + MDH
- (f) Total Derated Hours (DH)= UDH + PDH
- (g) Planned Outage Hours (POH): The sum of hours (or fraction of hours) over the reporting period, in which the Generation Unit is in a Planned Outage State.
- (h) Maintenance Outage Hours (MOH): The sum of hours (or fraction of hours) over the reporting period, in which the Generation Unit is in a Maintenance Outage State.

- (i) Forced Outage Hours (FOH): The sum of hours (or fraction of hours) over the reporting period, in which the Generation Unit is in a Forced Outage State.
- (j) Unplanned Outage Hours (UOH): FOH + MOH
- (k) Total Outage Hours (OH): UOH + POH
- (l) Period Hours (PH): Total Number of Hours in the reporting period

2.2.4. It shall be verified that FAH + DH + OH = PH

2.3. INDIVIDUAL PERFORMANCE INDICATORS

2.3.1. Generation availability of the Generation Licensees will be assessed through a set of Performance Indicators that will measure the availability of each Generation Unit.

2.3.2. The Individual Availability Performance Indicators to measure Availability of each individual Generation Unit will be:

- (a) The Availability Indicator is the percentage of a period “t” a Generation Unit “u” is in the Available state:

$$AVAIL_u^t = \frac{FAH + DH}{PH}$$

- (b) The Equivalent Availability Indicator is the percentage of the Dependable Capacity (Dependable Maximum Output) of a Generation Unit “u” available during a period “t”. This availability includes both outages and Deratings.

$$E_AVAIL_u^t = \frac{FAH + \sum_i DH_i * \left(1 - \frac{SD_i}{NDC}\right)}{PH}$$

Where:

DH_i : Number of Hours in the Derated state “i”

SD_i : Size of Derating, in the Derated state “i”

NDC : Net Dependable Capacity of Generation Unit “u”

PH : Total number of hours during the reporting period.

- (c) The Unplanned Unavailability Indicator is the percentage of the Dependable Capacity (Dependable Maximum Output) of a Generation Unit “u” is not available during a period “t” due to Unplanned Outages.

$$U_UNAVAIL_u^t = \frac{UOH + \sum_i UDH_i * \left(\frac{SD_i}{NDC}\right)}{PH}$$

Where:

UDH_i : Number of Hours in the Unplanned Derated state “i”

And other notifications were as defined before.

2.3.3. Forced Generation Outages of the Generation Licensees will be assessed through a set of Performance Indicators that will measure the unavailability of each Generation Unit due to forced reasons.

2.3.4. The Individual Forced Outage Performance Indicators to measure Forced Outages of each individual Generation Unit will be:

- (a) The Forced Outage Factor (FOF) Indicator represents the percentage of a period “t” a Generation Unit “u” was unavailable due to Forced Outages.

$$FOF_u^t = \frac{FOH}{PH}$$

Where other notification was as defined before.

- (b) The Equivalent Forced Outage Factor Indicator is the percentage of Dependable Capacity unavailable due to Forced Outage in a Generation Unit “u” during a period “t”.

$$E_FOF_u^t = \frac{FOH + \sum_i FDH_i * \left(\frac{SD_i}{NDC} \right)}{PH}$$

Where:

FDH_i : Number of Hours in the Forced Derated state “i”

And other notifications were as defined before.

2.3.5. Start Up reliability of Generation Units, when they are asked to enter into service by the System Operator, will be assessed through the Failed Start Up Performance Indicator. Fail Start Up Performance Indicator is the percentage of times during a period “t” that a Generation Unit “u” failed to start up. It will be calculated as:

$$FAILST_u^t = \frac{FS}{AS}$$

Where:

FS : Failed Unit Starts

AS : Attempted Unit Starts

2.3.6. In the case that during the reporting period one or more Outages have occurred, that qualifies as Force Majeure Outage, the above mentioned indicators will be calculated excluding the duration of this or these Outages, reducing the value of PH accordingly.

2.4. OVERALL PERFORMANCE INDICATORS

2.4.1. The Power Plant (PP) (Overall) Performance Indicators will measure the performance of the Power Plant as a whole, and they will be calculated as a weighted average of the Individual Performance Indicators of the Generation Units included in the Power Plant.

2.4.2. Overall Performance Indicators will be:

- (a) The Power Plant Availability Indicator (PP_AVAIL), which is a measure of the percentage of a period “t” the Power Plant is available.

$$PP_AVAIL^t = \frac{\sum_u AVAIL_u^t * NMC_u}{\sum_u NMC_u}$$

Where:

NMC_u : Net Maximum Capacity of Generation Unit “u”

- (b) The Power Plant Equivalent Availability Indicator, which is the percentage of the Dependable Capacity (Dependable Maximum Output) of a Power Plant availability during a period “t”.

$$PP_E_AVAIL^t = \frac{\sum_u E_AVAIL_u^t * NMC_u}{\sum_u NMC_u}$$

Where:

NMC_u : Net Maximum Capacity of Generation Unit “u”

- (c) The Power Plant Unplanned Unavailability Indicator, which is the percentage of the Dependable Capacity (Dependable Maximum Output) of a Power Plant, is not available during a period “t” due to Unplanned Outages.

$$PP_U_UNAVAIL^t = \frac{\sum_u U_UNAVAIL_u^t * NMC_u}{\sum_u NMC_u}$$

Where:

NMC_u : Net Maximum Capacity of Generation Unit “u”

- (d) The Power Plan Forced Outage Factor Indicator, which represents the percentage of a period “t” a Power Plant was unavailable due to Forced Outages.

$$PP_FOF^t = \frac{\sum_u FOF_u^t * NMC_u}{\sum_u NMC_u}$$

Where:

NMC_u : Net Maximum Capacity of Generation Unit “u”

- (e) The Power Plant Equivalent Forced Outage Factor Indicator, which is the percentage of Dependable Capacity unavailable due to Forced Outage in a Power Plant during a period “t”.

$$PP_E_FOF^t = \frac{\sum_u E_FOF_u^t * NMC_u}{\sum_u NMC_u}$$

Where:

NMC_u : Net Maximum Capacity of Generation Unit “u”

- (f) The Power Plant Fail Start Up Performance Indicator, which is the percentage of times during a period “t” an average unit of the Power Plant failed to start up.

$$PP_FAILST^t = \frac{\sum_u FAILST_u^t * NMC_u}{\sum_u NMC_u}$$

Where:

NMC_u : Net Maximum Capacity of Generation Unit “u”

2.5. REPORTING PERIOD AND TOLERANCES OF PERFORMANCE INDICATORS

2.5.1. The calculation of the Individual and Overall Availability Indicators will be done by the Generation Licensee on a monthly and yearly basis. When calculated on a yearly basis, the period “t” mentioned above shall be considered as a calendar year. When calculated on a monthly basis the pre-specified period shall be considered from the beginning of the calendar year up to the month the Performance Indicator is calculated.

2.5.2. The ERC will assign the numerical values for the tolerances of each Availability Performance Indicator for the Generation Licensee taking into consideration past performance and a benchmarking with international generation companies.

2.5.3. The tolerances for the Performance Indicators are established in Annex 1. These tolerances could be changed by the ERC from time to time, for new Generation Licensees, but they will remain unchanged during term of each issued License. Tolerances may be different for similar units, depending of their Age.

3. SECTION: MONITORING AND CONTROL

3.1. CONTROL PHASES

3.1.1. The implementation of the Performance Indicators and this Generation Performance Standards shall be done in two consecutive Control Phases.

3.1.2. The first Control Phase shall be called Control Phase 1 or adaptation Control Phase, and will have duration of one year, after the ERC approval of this Generation Performance Standards or the granting of a generation licence that includes Performance Indicators in accordance with this Generation Performance Standards. During Control Phase 1 the Generation Licensee will have the following obligations:

- (a) Provide the ERC monthly the numerical values resulting from the calculation of Individual and Overall Performance Indicators, based on the information system existing at the Power Plant.
- (b) Organize procedures and information systems, to develop and maintain the Outage Registers defined in 2.2.2 and properly calculate all Performance Indicators as defined in this Performance Standards.

3.1.3. The Final Control Phase will begin at the end of Control Phase 1.

3.1.4. During the Final Control Phase, the Generation Licensee will have the following obligations:

- (a) Calculate and send to the ERC the all the Individual and Overall Performance Indicators as defined and established in this Generation Performance Standards.

- (b) Operate and maintain each Generation Unit and the Power Plant as a whole, in order to comply with the Individual and Overall Performance Indicators within the tolerances approved by the ERC.

3.2. INFORMATION SYSTEM, MONITORING AND CONTROL

3.2.1. Before the end of Control Phase 1, the Generation Licensee shall prepare and submit a report to the ERC for approval, containing adequate documentation regarding procedures and information systems to be implemented in order to control Generation Outages and Deratings, and to calculate Performance Indicators in accordance with this Generation Performance Standards.

3.2.2. The ERC will have the right and the Generation Licensee shall allow the ERC or its authorised representatives to inspect and revise the Outage Registers defined in 2.2.2 of this Generation Performance Standards, in order for the ERC to audit the process, data and the accuracy of the information submitted periodically by the Generation Licensee to the ERC. The ERC will have the right to hire qualified companies or persons to perform this activity on its behalf.

3.2.3. With the purpose of carrying out suitable control and monitoring of the obligations regarding Outages, Deratings and associated Performance Indicators, the Generation Licensee shall submit to the ERC, in a suitable organized manner or in such format as the ERC may establish, the following monthly information:

- (a) For each Generation Unit
 - (i) Total number of starts and attempted starts
 - (ii) Total Energy generated
 - (iii) Total time the unit was connected to the system
 - (iv) List of the Outages and Deratings of each Generation Unit, with indication of dates and duration
 - (v) List of Outages or Deratings that qualifies as Force Majeure, including the reports and/or documents that support that the Outage or Derating qualifies as Force Majeure.
 - (vi) Individual Performance Indicators as calculated until that month of the calendar year, as established in this Generation Performance Standards.
- (b) For the whole Power Plant
 - (i) Overall Performance Indicators as calculated until that month of the calendar year, as established in this Generation Performance Standards.

The ERC will issue directives regarding the format in which the above mentioned information will be supplied.

3.2.4. The ERC shall have the right to request additional information as necessary to perform its monitoring and control role, and the Generation Licensee shall allow the access to the primary documentation and/or send the necessary data regarding Outages or Deratings as requested by the ERC. The deadline to submit this additional information shall be not less than seven (7) Business Days from the date of receipt of the request by the Generation Licensee.

3.3. NON COMPLIANCE WITH ESTABLISHED TOLERANCES

3.3.1. During Control Phase 1, the Generation Licensee will not be enforced to comply with the established tolerances for the Performance Indicators. The Generation Licensee shall calculate the Individual and Overall Performance Indicators and submit to the ERC the information established in this Generation Performance Standards in order for the ERC to evaluate the performance of the Generation Licensee.

3.3.2. In case that, during Control Phase 1, a Generation Licensee considers that, due to obsolescence or current or expected technical conditions of a Generation Unit, it will be unable to comply with the tolerances of any of the Individual or Overall Performance Indicators, it shall communicate this situation to the ERC, with adequate supporting documentation. The ERC will evaluate the submitted documentation, and may specify different tolerances for this Generation Unit, or group of Generation Units.

3.3.3. During Final Control Phase, if the Generation Licensee fails to perform in one or more of the Overall or Individual Performance Indicators established in this Performance Standard, not later than ninety (90) calendar days after the end of the year, it shall submit to the ERC for approval a detailed report with an action plan to solve or mitigate the deficiency. The report shall include, among others, the following:

- (a) Description of the current situation and the detected deficiency
- (b) Analysis of the causes of the deficiencies
- (c) Remedial actions to correct the situation, including immediate and medium term actions) and expected improvements
- (d) Detailed work-plan with the proposed actions and required investments,

3.3.4. When the Generation Licensee submits a report in accordance to the previous paragraph, the ERC will review the proposed actions and may request clarifications or modifications prior to approval. Once approved, the proposed actions will be binding to the Generation Licensee and the ERC shall have the right to monitor and audit its effective execution. During the period required to implement the remedial actions, the ERC will have the right to exempt the Generation Licensee from compliance with the affected Overall or Individual Performance Indicators, and/or to modify the tolerances in accordance with the approved plan.

4. SECTION: NON COMPLIANCE

4.1. DEFINITION

4.1.1. If the Generation Licensee fails to fulfil all the provisions established in this Performance Standard, it shall be considered a Non Compliance situation.

4.1.2. A Non Compliance situation will include (but not be limited to):

- (a) Failure to provide the ERC, on time, with all the information established in this Generation Performance Standards
- (b) Providing the ERC incomplete or inaccurate data or reports, in particular inaccuracies or other problems verified by the audits of the ERC in the information submitted by the Generation Licensee.
- (c) Failure to implement in time the procedures and information systems established in this Performance Standard
- (d) Failure or unsuitable delays in the execution of the approved remedial actions and plans to improve Generation availability

4.2. PENALTIES

4.2.1. If the Generation Licensee is in a Non Compliance situation, the ERC can apply penalties, according to Article 40 of the General Electricity Law and consider the situation a non-compliance with its licence conditions.

ANNEX 1: TOLERANCES TO THE AVAILABILITY, FORCED OUTAGE AND FAILED STARTS INDICATORS

The following tolerances will apply for the Individual Performance Indicators, unless the ERC, when issuing a new license to a Generation Licensee, specifies different values for one or more of these tolerances:

Indicator	FUEL AND SIZE		
	Units under 100 MW	Units above or equal 100 MW	Gas Turbines
$AVAIL_u$	> 83,0 %	> 85,0 %	> 90,00 %
E_AVAIL_u	> 81,0 %	> 83,0 %	> 88,00 %
$U_UNAVAIL_u$	< 10.0 %	< 9.0 %	< 7 %
FOF_u	< 6.0 %	< 5,0 %	< 5,0 %
E_FOF_u	< 8.0 %	< 7,0 %	< 6,0 %
$FAILST_u$	< 15,0 %	< 15,0 %	< 15,00 %

Tolerances for Overall Performance Indicators will be calculated according with the following formula:

$$TOL_OVL_i = \frac{\sum_u TOL_IND_i^u * NMC_u}{\sum_u NMC_u}$$

Where:

TOL_OVL_i : Tolerance for the Overall Performance Indicator “i”

TOL_IND_i : Tolerance for the Individual Performance Indicator “i” , for Generation Unit “u”, according with the tables above.

NMC_u : Net Maximum Capacity of Generation Unit “u” of the Power Plant

“i”: Performance Indicator: $AVAIL$; E_AVAIL ; $U_UNAVAIL$; FOF ; E_FOF and $FAILST$