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**INDUSTRY STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

DL/T 793.4-2019

**Power plant reliability assessment procedures - Part 4: Pumped
storage units**

发电设备可靠性评价规程 第4部分：抽水蓄能机组 清晰版
(English Translation)

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Foreword

This standard was drafted in accordance with the rules given in GB/T 1.1-2009 "Guidelines for Standardization Work Part 1: Standard Structure and Compilation".

This standard specifies the corresponding technical requirements and methods for the reliability statistics, analysis and evaluation of pumped storage units. DL/T 793 "Power Generation "Equipment Reliability Evaluation Regulations" is a series of standards, divided into seven parts, of which the published standards are.

--Part 1: General rules;

--Part 2: Coal-fired units;

--Part 5: Gas turbine generator set.

This standard is part 4 of DL/T 793.

This standard is compiled in accordance with the relevant content of the "Reliability Evaluation Regulations for Power Generation Equipment Part 1: General Principles". Therefore, there is no for the definitions or provisions of general terms and evaluation indicators, not in Appendix A and Appendix B, please refer to "Reliability Evaluation of Power Generation Equipment Regulation Part 1: General Rules.

This standard was proposed by the China Electricity Council.

This standard is under the jurisdiction of the Power Industry Reliability Management Standardization Technical Committee.

Drafting organizations of this standard. China Electricity Council, State Grid Xinyuan Holdings Co., Ltd.

1 Scope

This section specifies the statistical scope, evaluation indicators and evaluation methods for the reliability of pumped storage units.

This section applies to the reliability evaluation of pumped storage units.

2 Normative references

The following documents are indispensable for the application of this document. For dated reference documents, only the dated version applies to this document.

For undated references, the latest version (including all amendments) applies to this document.

GB/T 36550-2018 Basic Terminology for Pumped Storage Power Station

3 Terms and definitions

Reliability for generating equipment the ability of power generation equipment to perform specified functions under specified conditions and within specified time intervals.

Gross maximum capacity (GMC) the maximum capacity that the unit can continuously carry in a given period. Generally, the rated capacity of the unit can be used.

Rated capacity (RC)

The output/input power of a generator motor running under specified conditions. Power generation conditions refer to the output electric power, expressed in MVA value; electric Working condition refers to the output shaft mechanical power, expressed in MW value. The rated capacity of the pumped storage unit can generally be the unit's nameplate rated capacity (INC).

Gross actual generation (GAG) the actual amount of electricity generated by the unit in a given period.

Gross maximum generation (GMG) the amount of electricity generated by the unit continuously operating at the maximum gross capacity during a given period.

Unit derated capacity (UNDC) the difference between the actual maximum continuous output and the gross maximum capacity or the rated capacity of the unit when the unit is in a reduced output state. Its number 3.7 Generating capacity (GC) the electric energy

produced by the unit in a certain period of time. (Quoted from GB/T 36550-2018).

Pumping capacity (PC) the electricity consumed by the unit for pumping water in a certain period of time. (Quoted from GB/T 36550-2018) 3.9 Pump-turbine it can be used as a hydraulic machine that can operate as a pump or as a turbine. (Quoted from GB/T 36550-2018) 3.10 Generator-motor A rotating electric machine that can be used as a generator and a motor. (Quoted from GB/T 36550-2018) 3.11 Static frequency converter Static frequency conversion equipment with a certain power composed of converter devices and DC reactors, generally consists of frequency conversion units, output it is composed of input/output unit, control protection unit and cooling unit. (Quoted from GB/T 36550-2018) 3.12 Synergic system Public oil, water, gas systems, plant power systems, metal structures, DC systems, static frequency conversion starting systems, water pipelines, reservoirs, etc., Equipment or systems that are unavailable for two or more units of the pumped storage power station due to its outage.

3.13

Operating mode

The operating status of the unit. (Quoted from GB/T 36550-2018) 3.13.1 DL/T 973.4-2019 Stop mode the unit is in a static shutdown state. (Quoted from GB/T 36550-2018) 3.13.2 Generator mode the water is discharged from the upper reservoir to the lower reservoir, driving the water pump and turbine runner of the unit to rotate to convert the water potential energy into electrical energy. (lead from GB/T 36550-2018) 3.13.3 Generator condenser mode After the water is compressed in the runner chamber, the runner rotates in the air, and the unit is connected to the grid for power generation. (Quoted from GB/T 36550-2018) 3.13.4 Pump mode the unit pumps water from the lower reservoir to the upper reservoir and converts electrical energy into water potential energy. (Quoted from GB/T 36550-2018) 3.13.5 Pump condenser mode After the runner chamber presses water, the runner rotates in the air, and the unit is connected to the grid in the pumping direction. (Quoted from GB/T 36550-2018) 3.13.6 Luncher mode the unit starts in a back-to-back manner, and the tractor runs in the direction of power generation and provides variable frequency current. The tractor will be pulled to the rated speed and connected to the grid A working condition. (Quoted from GB/T 36550-2018) 3.14 Mode transition the process of a unit from one working condition to another. (Quoted from GB/T 36550-2018) 3.15 Static frequency converter startup the start mode that uses the static frequency conversion device to drive the unit in the pumping direction through the start circuit. (Quoted from GB/T 36550-2018) 3.16 Back to back startup One unit is started in the driving mode, and the other unit is driven to start in the pumping direction through the start loop. (quoted GB/T 36550-2018) 3.17 DL/T 973.4-2019 Regular maintenance for units with frequent startups and shutdowns and no scheduled maintenance and shutdown plans in the current month, according to the needs of the power station and system operation conditions, monthly dispatch approval Scheduled unit inspections.

3.18

Active (ACT)

The equipment is in a state for statistical evaluation. The use status is divided into available and unavailable.

3.18.1

Available (A)

The equipment is in a state capable of performing predetermined functions, regardless of whether it is running or not, and regardless of how much power it can provide. Available status Including running and standby.

3.18.1.1

Run in service(S)

For equipment, it refers to the state of the generator, tuned camera or motor being electrically connected to the power system (including trial operation), it can be operated at full output, planned or unplanned to reduce output.

3.18.1.2

Reserve shutdown (RS) the device is in a usable but not running state.

3.18.1.3

Unit derating

The unit cannot reach the state of maximum gross capacity operation (excluding normal output adjustment according to the load curve). Unit reduction in output can be divided into plans Reduced output and unplanned reduction of output.

a) planned derating

The crew reduced their output during the scheduled period as planned.

b) unplanned derating Unpredictable unit reduced output.

3.18.2

Unavailable (U)

The equipment is in an inoperable or standby state for whatever reason. The unavailable state is divided into planned outage and unplanned outage.

3.18.2.1

Planned outage (PO)

The unit is in the state of the planned maintenance period (including inspection, test,