

HJ

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**Technical specification to thermal discharge monitoring for
coastal nuclear power plants based on satellite remote sensing
(on trial)**

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1 Scope of application

This standard specifies the technical process and methods for satellite thermal infrared remote sensing monitoring of thermal drainage in Binhai Nuclear Power Plant.

This standard is applicable to the supervisory monitoring of the thermal impact of surface seawater caused by the thermal drainage of coastal nuclear power plants.

The heat impact monitoring of other industrial water discharged into the water body can be implemented with reference to this standard.

2 Normative references

This standard refers to the following documents or clauses thereof. For dated references, only the dated version applies to this standard.

For undated references, the latest edition (including all amendments) applies to this standard.

GB 3097 seawater quality standard GB/T 13989 National Basic Scale Topographic Map Framing and Numbering GB/T 15968 Remote Sensing Image Plan Production Specification GB/T 34514 Land Observation Satellite Remote Sensing Data Distribution and User Service Requirements HJ 1037 Guidelines for Environmental Impact Assessment of Intake and Drainage of Nuclear Power Plants (Trial)

3 Terms and Definitions

The following terms and definitions apply to this standard.

Thermal discharge thermal discharge Cooling water and industrial process water used to transport waste heat, the water temperature is higher than the temperature of the natural water body in the discharge area.

[Source. HJ 1037-2019, 3.9] **3.2 potential thermal plume area** the possible temperature rise envelope range of warm drainage in space, that is, the potential range of warm drainage discharge.

reference temperature an evaluation criterion set for objectively extracting and evaluating the influence area and intensity of warm water drainage, represented by the symbol T_0 .

temperature rising area the temperature of the receiving water body caused by warm drainage exceeds the range of the natural water body temperature in the area.

average temperature method of multi-discrete points when there is a $0.5\text{ }^{\circ}\text{C}$ diving area boundary line, the boundary line is used as a reference, otherwise the current image is not less than 100 km^2 higher than the remote the boundary line of the area with an average temperature of $0.5\text{ }^{\circ}\text{C}$ in the sense inversion is used as a reference, and within the buffer zone. 200 m to 500 m outside the reference boundary line, the space is distributed at equal intervals.

The method of setting a datum reference position and using the average temperature retrieved from remote sensing in this datum reference position as the reference temperature is called the discrete multi-point averaging method.

Note: The discrete multi-point averaging method belongs to the position reference method, and each scene image is extracted independently.

average temperature method of adjacent replaceable area Based on the statistics of historical temperature data retrieved from remote sensing, the most similar adjacent stable area outside the $0.5\text{ }^{\circ}\text{C}$ submerged discharge area was selected as the base.

The quasi-reference position, and the method of using the average temperature retrieved from remote sensing in this reference position as the reference temperature is called the adjacent area substitution method.

Note: The adjacent area substitution method belongs to the position reference method, and each scene image is extracted independently.

average temperature method of gulf area in the bay space range, the method of taking the average temperature retrieved from remote sensing after deducting the range of the submerged discharge area as the reference temperature is called bay average.

temperature method.

Note: The bay average temperature method is a method of numerical statistics, and each image is extracted independently.

4.1 Mission Objectives

Using satellite thermal infrared remote sensing data, the sea surface temperature near the nuclear power plant is obtained by inversion, and the corresponding reference temperature is obtained according to 5.2.6, and based on According to 5.2.7, the spatial range of thermal drainage and the spatial distribution of different intensities are extracted from the results of sea surface temperature monitored by thermal infrared remote sensing.

4.2 Monitoring indicators

There are two monitoring indicators in this standard.

- a) Spatial distribution range of surface temperature rise of warm drainage;
- b) Surface distribution area of different temperature rise intensity.

4.3 Remote sensing data source requirements

The requirements for remote sensing data sources of thermal infrared satellites for remote sensing monitoring of temperature and drainage of nuclear power plants should meet the following conditions.

- a) Spatial resolution. selected according to the actual situation, at least the spatial range affected by the first-level temperature rise intensity (see Table 1) can be obtained;
- b) Spectral range. 8.0 μm ~12.5 μm spectrum range should be selected for sea surface temperature inversion, and 0.39 μm ~2.53 μm spectrum should be selected for water-land separation segment range;
- c) Noise equivalent temperature difference. the noise equivalent temperature difference in the 8.0 μm ~12.5 μm spectral band should be ≤ 0.5 K;
- d) Absolute radiometric calibration accuracy. the absolute radiometric calibration accuracy in the 8.0 μm ~12.5 μm spectrum should be ≤ 1 K;
- e) Scope of data. it should completely cover the submerged area of the nuclear power plant with warm drainage;
- f) Cloud cover. the cloud cover over the submerged discharge area of the nuclear power plant should not exceed 5%;
- g) Others. Data with stripes should be avoided in processing, or the data processed by the strip repair method provided by the official image publishing unit should be avoided.

No stripe data.

5.1 Monitoring technical process

Figure 1 shows the technical process of satellite remote sensing monitoring of nuclear power plant temperature and drainage.

5.2.1 Spatial clipping

The technical requirements for setting the space clipping range are as follows.

- a) Centering on the discharge outlet of the warm water of the nuclear power plant, the space should completely cover the area affected by the warm water;
- b) The need for expressing surrounding landmark geographical elements should be taken into account when mapping, and the scope of spatial clipping should be appropriately expanded.

5.2.2 Geometric Correction

The processing requirements of geometric correction technology are as follows.

- a) Common projection methods such as WGS84 UTM, Xi'an 80, and CGCS2000 should be used;
- b) The reference image or spatial point coordinate information should be used for geometric correction, and the correction accuracy should be controlled within 1 pixel.

5.2.3 Absolute radiometric calibration

The operation steps of absolute radiation calibration technology are as follows.

- a) Obtain the absolute radiation calibration coefficients corresponding to different spectrum bands from the satellite data header file or the official satellite website;
- b) Using the absolute radiometric calibration formula given by the satellite, convert the gray value of the image into apparent radiance.

5.2.4 Separation of land and water

The technical requirements for water and land separation are as follows.

- a) For a fixed water bank that is not affected by tides, separate land and water through a fixed boundary line to obtain a water and land mask;
- b) For waterfronts that are easily affected by tides, visible light, near-infrared and thermal-infrared images are used separately for each scene image.

Water body index, angular distance similarity index, etc., to obtain water and land masks.