

## PART 1 GENERAL

### 1.1 Section includes

- A. Dissolved Hydrogen and Oxygen for monitoring in nuclear applications (RCS in PWR, Reactor water in BWR)

### 1.2 Measurement Procedures

- A. The method of measurement for dissolved oxygen will be Luminescent measurement technology.
  - 1. The sensor is coated with a luminescent material.
  - 2. An Active fluorescent spot is excited with blue light and a red luminescent light is detected from the spot.
  - 3. Increased oxygen in the sample decreases the time taken for the spot's fluorescence to decay and this correlates directly to the oxygen concentration in the sample.
- B. The method of measurement for dissolved hydrogen will be Thermal conductivity technology.
  - 1. The sensor's measuring technique is a combination of a gas diffusion membrane and a gas thermal conductivity detector.
  - 2. The small volume enclosed between the diffusion membrane and the thermal conductivity detector is periodically flushed with a purge gas.
  - 3. After each purge, the gas to be measured diffuses from the sample through the membrane, changing the thermal conductivity of the gas surrounding the detector.
  - 4. It is the rate of change of the thermal conductivity that allows the concentration of the gas to be calculated.

### 1.3 Alternates

- A. Other methods of Dissolved Oxygen or Dissolved Hydrogen measurement are not acceptable.

### 1.4 System Description

- A. Performance Requirements for oxygen sensor
  - 1. Measurement range: 0 to 2000 ppb.
  - 2. Accuracy :  $\pm 0.8$  ppb or 2% whichever is greater
  - 3. Limit of detection: 0.6 ppb minimum
  - 4. Resolution: 0.1 ppb
  - 5. Repeatability:  $\pm 0.4$  ppb or 1% whichever is greater
  - 6. Response time < 10 s (gas phase) ; < 30s (in water)
- B. Performance Requirements for hydrogen sensor (RCS in PWR)
  - 1. Measurement range: 0 to 10 ppm or 0 to 120 cc/kg.
  - 2. Accuracy :  $\pm 8$  ppb (or 0.1 cc/kg) or 1% (within 5°C of cal temperature), whichever is greater
  - 3. Limit of detection:  $\pm 8$  ppb (or 0.1 cc/kg)
  - 4. Cycle time: 17s
- C. Performance Requirements for hydrogen sensor (Reactor water in BWR)
  - 1. Measurement range: 0 to 2 ppm or 0 to 25 cc/kg.
  - 2. Accuracy :  $\pm 2$  ppb (or 0.03 cc/kg) or 1% (within 5°C of cal temperature), whichever is greater
  - 3. Limit of detection:  $\pm 2$  ppb (or 0.03 cc/kg)
  - 4. Cycle time: 17s

## 1.5 Environmental Requirements

### A. Operational Criteria

1. Sample pressure: 1 to 20 bar abs (14.5 to 290 psia)
2. Sample temperature: 0 to 50 degrees C
3. Storage temperature: -5 to 100 degrees C
4. Operating humidity: 5 to 95 percent non-condensing

## 1.6 Warranty

- A. The product includes a one-year warranty from the date of shipment.

## PART 2 PRODUCTS

### 2.1 Manufacturer

#### A. Hach Company, Loveland, CO

1. Model Orbisphere 510 controller
2. Model Orbisphere K1200 Luminescent Dissolved Oxygen sensor
3. Model Orbsiphere 31290 Thermal Conductivity Dissolved Hydrogen sensor

### 2.2 Manufactured Unit

#### A. Dissolved Oxygen:

1. The sensor shall continuously measure the concentration of oxygen (O<sub>2</sub>) in de-aerated water
2. The measurement technology shall be luminescent measurement technology.
3. The measuring range shall be from 0 to 2000 ppb O<sub>2</sub>.
4. The minimum detection limit shall be 0.6 ppb O<sub>2</sub>.
5. The accuracy shall be  $\pm 0.8$  ppb or 2% of the measured value, whichever is greater.
6. The response time (90%) shall be less than 10 seconds for gas phase and less than 30 seconds for water process.
7. The calibration method for the sensor shall be gas phase calibration.
8. The calibration frequency should be of 12 months or better with a measurement interval of 2 seconds
9. The sensor shall be model Orbisphere K1200 Luminescent Dissolved Oxygen Sensor manufactured by Hach Company

#### B. Dissolved Hydrogen:

1. The sensor shall continuously measure the concentration of hydrogen (H<sub>2</sub>) in de-aerated water
2. The measurement technology shall be thermal conductivity technology.
3. The measuring range shall be from 0 to 2 ppm (0 to 25 cc/kg) dissolved H<sub>2</sub> (Reactor water in BWR)
4. The measuring range shall be from 0 to 10 ppm (0 to 120 cc/kg) dissolved H<sub>2</sub> (RCS in PWR)
5. The minimum detection limit shall be 2 ppb (0.03 cc/kg) dissolved H<sub>2</sub> (Reactor water in BWR).
6. The minimum detection limit shall be 8 ppb (0.1 cc/kg) dissolved H<sub>2</sub> (RCS in PWR).
7. The accuracy shall be  $\pm 2$  ppb (or 0.03 cc/kg) or 1% whichever is greater (Reactor water in BWR).
8. The accuracy shall be  $\pm 8$  ppb (or 0.1 cc/kg) or 1% whichever is greater (RCS in PWR)
9. The measurement cycle time shall be 17s.

10. The calibration method for the sensor shall be gas phase calibration.
11. The calibration frequency should be of 12 months or better
12. The sensor shall be model Orbisphere 31290 Thermal Conductivity Hydrogen Sensor manufactured by Hach Company

#### Accessories

#### 2.3

- A. Sensor Cable 5 m (16.4 Ft)

### PART 3 EXECUTION

#### 3.1 Preparation

- A. Wall mount or Panel mount controller
- B. Clearances: none required.
- C. Storage temperature: -5 to 100 degrees C

#### 3.2 Installation

- A. Contractor will install the K1200/31290 sensors and 510 controller in strict accordance with the manufacturer's instructions and recommendation.
- B. Manufacturer's representative will include a half-day of start-up service by a factory-trained technician.
  1. Contractor will schedule a date and time for start-up.
  2. Contractor will require the following people to be present during the start-up procedure.
    - a. General contractor
    - b. Hach Company factory trained representative
    - c. Owner's personnel

END OF SECTION