



## **A Report on Industrial Visit to “Nuclear Power Corporation of India Limited (NPCIL)”, Kakrapar**

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### **About Plant**

Kakrapar Atomic Power Station is a nuclear power station in India, which lies in the proximity of the city Vyara in Gujarat state. It consists of two 220 MW pressurized water reactors with heavy water as moderator (PHWR). The construction costs originally were estimated to be 3.8252 billion rupees, the plant was finally finished at a price of 13.35 billion rupees. Construction of units 3&4 started in November 2010. In January 2003, KAPS Unit-1 went critical on 3 September 1992 because of a leakage in the cooling loop and began commercial electricity production a few months later on 6 May 1993. KAPS Unit-2 went critical on 8 January 1995 and began commercial production in September 1, 1995. CANDU Owners Group (COG) declared K.A.P.S. as the best performing pressurized heavy water reactor.

Nuclear power corporation of India limited(NPCIL) is Public Sector Enterprise under the administrative control of the **Department of Atomic Energy (DAE)**, Government of India. It was established on 17th September, 1987. There are 20 units running under the NPCIL all over the India. Approximated installed capacity is 4780Mwe. All the Nuclear power plants are ISO-14001 and IS-18001 certified. The nuclear power plants under NPCIL are situated at Tarapur, Rawatbhata, Kalpakkum, Narora, Kakrapar and Kaiga. The type of reactors is BWR or PHWR.

### **Mission of NPCIL**

To develop nuclear power technology and to produce nuclear power as a safe, environmentally benign and an economically viable source of electrical energy to meet the increasing electricity needs of the country.

### **About Nuclear plant at Kakrapar**

Kakrapar Atomic Power Station is a nuclear power station in India, which lies in the proximity of the city of Vyara in the state of Gujarat. Commercial operation of plant has started on May 6, 1993. In plant there are two pressurized reactors of 220MW with a heavy water as moderator (PWHR). The construction costs originally were estimated to be 3.8252 billion rupees; the plant was finally finished at a price of 13.35 billion rupees. Construction of units 3&4 started in November 2010. Kakrapar Nuclear Plant has won so many national and international awards for their safety and performance.

India's Nuclear strategy is classified in 3 stages: (1) PHWR (2) FBR (3) Breeder reactor.

Kakrapar Nuclear power plant is working on stage 1. New two plants which are under construction is also working on stage 1 and it will produce 700MWe.



| Technical Data               |                 |
|------------------------------|-----------------|
| Type of reactor              | PHWR            |
| Gross electricity generation | 2* 200 MWe      |
| Type of Fuel                 | Natural Uranium |
| Primary coolant              | Heavy water     |
| Number of bundles            | 3672            |
| Number of coolant channel    | 306             |
| Length of bundle             | 49.5 cm         |
| Diameter of bundle           | 8.15 cm         |
| Weight of bundle             | 16.5 kg         |
| Weight of uranium oxide cell | 15 kg           |

| Constructional Data of Units |                           |
|------------------------------|---------------------------|
| Main Plant Area              | 1000 x 700 m <sup>2</sup> |
| Excavation Earth & Rock      | 387000 m <sup>3</sup>     |
| Concrete/ cement             | 235000 MT / 131000MT      |
| Structural Steel/ RE Steel   | 15000MT / 25000MT         |
| Piping/SS Tubing             | 55km                      |
| Power & Control Cable        | 190 Km & 250Km            |
| Tallest Structure            | Unit-1 NDG(126.5m)        |

### Details of Constructional Element



Construction of Calandria wall

**Calandria:** Made of stainless steel, 6.05m of diameter, 4.65m of length

**End Shield:** Diameter of end shield is 5.2m

**Channel:** 5.33 m of zircoally tube (coolant tube)



**Operating Performance of the Plant**

Location : Kakrapar, Surat, Gujarat

| Unit | Reactor Type                          | Capacity(MWe) | Date of Commercial Operation |
|------|---------------------------------------|---------------|------------------------------|
| 1    | Pressurised Heavy Water Reactor(PHWR) | 220           | May 6, 1993                  |
| 2    | Pressurised Heavy Water Reactor(PHWR) | 220           | September 1, 1995            |

**Cumulative Generation upto September – 2017 (Since Commercial Operation)**

| Unit | Cumulative Generation(MUs) |
|------|----------------------------|
| 1    | 28891                      |
| 2    | 29169                      |

**Generation Statistics during the Current Financial Year ( 2017-2018 )**

| Unit | Gross Generation(MUs) | Capacity Factor (%) | Period              |
|------|-----------------------|---------------------|---------------------|
| 1    | 0                     | 0                   | Apr 2017 - Sep 2017 |
| 1    | 0                     | 0                   | Sep 2017 - Sep 2017 |
| 2    | 0                     | 0                   | Apr 2017 - Sep 2017 |
| 2    | 0                     | 0                   | Sep 2017 - Sep 2017 |

**Previous Years Generation Statistics**

| Unit | Year      | Gross Generation(MUs) | Capacity Factor (%) | Availability Factor (%) |
|------|-----------|-----------------------|---------------------|-------------------------|
| 1    | 2016-2017 | 0                     | 0                   | 0                       |
| 1    | 2015-2016 | 1608                  | 83                  | 82                      |
| 1    | 2014-2015 | 1943                  | 101                 | 99                      |
| 1    | 2013-2014 | 1862                  | 97                  | 94                      |
| 2    | 2016-2017 | 0                     | 0                   | 0                       |
| 2    | 2015-2016 | 421                   | 22                  | 24                      |
| 2    | 2014-2015 | 1586                  | 82                  | 88                      |
| 2    | 2013-2014 | 1891                  | 98                  | 100                     |

**Units under Construction:-**

In Kakrapar nuclear power plant there are two PHWR reactors named as KAPS-1 and KAPS-2. Both can generate electricity of 200MWe to 220MWe.KAPS-3 and KAPS-4 plants are under construction and their capacity to produce electricity of 700MWe. Expected date of commercial operation of KAPS – 3 AND KAPS – 4 are June – 2015 and December – 2015 respectively.

| Unit | Reactor type                           | Capacity (MWe) | Construction Start Date | Expected year of Commencement |
|------|--|----------------|-------------------------|-------------------------------|
| 3    | Pressurised Heavy Water Reactor (PHWR) | 700            | 22 November 2010        | 2018                          |
| 4    | Pressurised Heavy Water Reactor (PHWR) | 700            | 22 November 2010        | 2019                          |



### **Activities on the Days of the Visit**

The bus had reached around 10.00 am at the Kakrapar site. We took entry for our visit at 11:00 am. In the visit, NPCIL authorities welcomed us on the Gate-Pass section. All the students had submitted their ID card photocopies there and registered first. We all moved to the main site of the plant by their bus. Then after reaching there, we were taken for the breakfast. After that, we moved to presentation hall. Then Mr. B.D.Vyas (NPCIL Official) came there along with two other engineers. They explained the working of Nuclear power plant with the help of demo structure of the plant. The questioning was also being taken by us and the satisfactory answers were given by them. Then they explained all the nuclear power plants which are established and are under construction in India. They also distributed two booklets. Later they discussed about the various activities about plant in nearby areas.

Then we all were moved towards the working site of the plant where we had seen the natural draught cooling tower and the forced draught cooling tower. We all were moved towards the safety and control department. There we had observed different control rooms for different turbine sections. All the control of the whole generation system was controlled by that control room containing different control switches and digital panels. This whole controlling system was controlled by 2 to 3 control engineers. There were two different sections in the control room. One of them was for the whole controlling of the power generation of unit -1 and other was for the power generation for the unit-2. Then we were taken to the plant where we had seen the condensers, heat exchangers, water circulating pumps.

We had also seen re-heaters. One of the engineers had given overview of the working of the heat exchangers and the other units. The steam which was generated was taken to the steam turbines and turbines were caused to generate the electricity which was generated by the generator. All the flows whether it was air flow or steam flow or water flow were flowing from the piping which was appearing to be a complex design of the plant. Though these much equipment were there the plant was very neat and tidy. We had also seen some release valves for releasing the unwanted flow of steam. This way, the complete information regarding each and every section of the plant was given by the allotted engineers and they also briefly explained regarding how this power generation was actually taking place.

They also explained that how this generated nuclear power was transmitted. They also discussed regarding how the backup power system was helpful in the case of power failure in the plant. After this we had seen the nuclear reactors from outside. One of the reactors was under the maintenance condition. One of those allotted engineers had told that the construction of two new plants each of capacity 700 MW were under construction and would get completed till year 2017. Then a whole grid system containing generators, transformers, electricity transfer cables were observed. After this complete explanation we had went to the exit. After the complete explanation of the nuclear





power plant we had been taken to the canteen for the lunch. After finishing the lunch we had travelled to the main gate by the company's transportation vehicle. Then after reaching at the main exit we had officially checked out and then after we had thanked the all authorities and left the plant.

**Schedule:**

| Date       | Branch/Course/Division                       | No of Students | Faculties                                      |
|------------|--|----------------|--|
| 04-10-2018 | Mechanical – A<br>(7 <sup>th</sup> Semester) | 65             | Prof. Harshal Shukla<br>Prof. Rikesh Prajapati |
| 06-10-2018 | Mechanical – B<br>(7 <sup>th</sup> Semester) | 65             | Prof. Pragnesh Chaudhari<br>Mr. Ajay Patel     |



Students of Final Year Mechanical at NPCIL-Kakrapar