EIA analysis of nuclear power project by Nuclear Power Corporation of India limited

Background of the technical report

Nuclear Power Corporation of India Limited (NPCIL) is planning to set up a 6,000 MWe nuclear power plant in Bhavnagar district of Gujarat. On behalf of the local community there, an NGO called Paryavaran Mitra requested the Centre for Science and Environment to technically evaluate the Environment Impact Assessment (EIA) report of the project.

Engineers India Limited has prepared the EIA report of the project with inputs from INDOMER, SACON and Anna University's Remote sensing department. The EIA report has been prepared based on the terms of reference (ToRs) set by Ministry of Environment and Forests (MoEF) on March 14, 2011.[1] The construction of the project will take place in three stages of 1000 MW * 2 units each at each stage.[2] (see *Table 1: Stages of the reactor*).

Table 1 : Stages of the reactor

Stage	Year of Completion
1	2019 - 20
2	2021 – 22
3	2022 - 23

Source: Engineers India Limited, New Delhi, Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujarat, pg 28 of 389

The study area includes a 1km exclusion zone where no habitation is permitted, 5km sterilized zone where developmental activities are not encouraged by the state government but people in the zone would carry out their normal activity and a 16 km emergency planning zone.[3]

The proposed plant at Mithivirdi will be set up in Talaja Taluka, Bhavnagar district, Gujarat which is 40 km from Bhavnagar town. The site is located on sea coast on west side of the Gulf of Khambhat.[4] The site falls under Coastal regulation zone (CRZ) category III[5] and the clearance for the same has been applied for. The area falls under seismic zone 3.[6] The latitude-longitude of the four corners of the project site is given as:

Corner	Latitude	Longitude
A	210 28' 55" N	72 0 14'43" E
B	210 29' 19" N	72 0 13' 51" E

[1] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 1 of 389

[2] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 302 of 389

[3] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 320 of 389

[4] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg V

[5] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 261 of 389

[6] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 10 of 389

Corner	Latitude	Longitude
C	210 27' 23" N	72 0 12' 49" E
D	210 26' 57" N	72 0 13' 45" E
Source : Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 10 of 389		

The total project area is 777 ha. The land selected for the project is predominantly agricultural. The total project area consists of 78.05 per cent agricultural land, 2.70 per cent forest land and 19.25 per cent waste land.[7] (See Table 2: *Project Area*)

Table 2 : Project Area

Land Use	Area in ha
Agricultural land	606.41
Forest land	20.97
Waste land	149.57

Land will be acquired from 340 khatedars for the construction of the project.[8] Three coastal villages of Mithvirdhi – Jaspara, Mandava and Khadapar are affected by this land acquisition and 749.67, 10.59 and 17.54 ha of land will be acquired from these villages respectively.[9] The site has been stated as the selection by government of India.[10]

Analysis

A) Technology Used: The Advance Passive Reactor Plant (Pressurized water reactor) is going to be adopted in the plant.[11]

Fuel Used: Enriched Uranium Di Oxide
Cost of the Project: under negotiation

CSE's Comment: Advance Passive reactor plant is called Westinghouse's AP 1000.[12] Originally the reactor was approved in the year 2005 in U.S.[13] after which the company resubmitted its modified design in 2007 but faced a hard time for its approval.[14] After 19 revisions of the design the company got its approval in December 2011.[15] The fear described was if there happens to be a leak on the side of the nuclear reactor wall owing to extreme events like earthquake, hurricane, etc., then the radiations would escape out of

[7] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg V

[8] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg VI

[9] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg VI

[10] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 271 of 389

[11] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 42 of 389

[12] http://www.sciencedirect.com/science/article/pii/S0029549306003190 as viewed on February 8, 2013

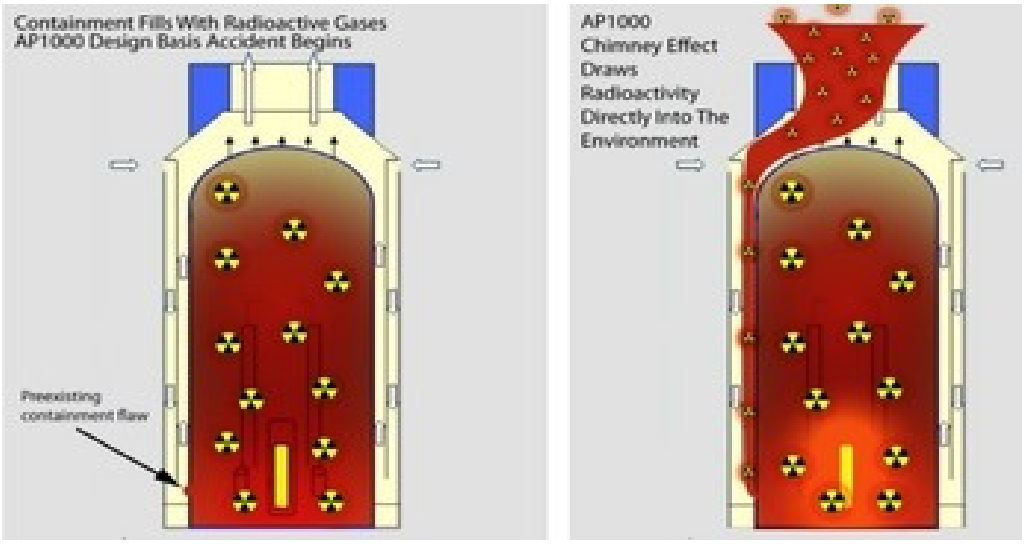
[13] http://www.nrc.gov/reactors/new-reactors/design-cert/amended-ap1000.html as viewed on February 8, 2013

[14] http://www.scientificamerican.com/article.cfm?id=slow-reactor-safety as viewed on February 8, 2013

[15] http://www.nytimes.com/2011/12/23/business/energy-environment/nrc-clears-way-for-new-nuclear-plant-construction.html?_r=0 as viewed on February 8, 2013

the chimney of the nuclear reactor. (see *Picture 1: Leaks in AP1000*).

Picture 1: Leaks in AP1000



Source: http://www.neimagazine.com/story.asp?storyCode=2056229

Such a concern and the impact of the situation has not been discussed in the EIA report. It is imperative to reassess this aspect especially with the controversy in America. Besides there are studies which say nuclear radiation on high doses causes weakening in concrete[16] and steel structures.[17] But there are no discussions on the possible high dose emission from the nuclear reactor and the measures taken to curb such emissions.

B) Marine EIA: Marine impact assessment of the project has been done by INDOMER Pvt. Ltd.[18] Shannon Weiner biodiversity index for the area varies between 3.9 – 4.3.[19] And hence it is interpreted in the report that the area is turning from pristine ecosystem to polluted in the present time.[20] The report also mentions that the area has scattered low patches of mangroves[21] and there are no coral reefs[22], endangered species[23], fishing activity in the area[24]. Modeling analysis has been done to predict the changes in the sea temperature on discharge of hot water in Chapter 7 says the report.[25] And the report also acknowledges the fact that there will be changes in the temperature of the sea due to the discharge of the sea water and this would serve an impact. But there is no mention on discharge study in Chapter 7 of the report. However in the executive summary of the

[16] http://www.inl.gov/technicalpublications/Documents/2906947.pdf as viewed on February 14,2013
[17] http://ir.lib.uwo.ca/cgi/viewcontent.cgi?article=2404&context=etd as viewed on February 14,2013
[18] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujarat*, pg VII of 389
[19] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujarat*, pg 208 of 389
[20] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujarat*, pg 221 of 389
[21] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujarat*, pg 217 of 389
[22] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujarat*, pg 221 of 389
[23] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujarat*, pg 225 of 389
[24] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujarat*, pg 220 of 389
[25] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujarat*, pg 259 of 389

report there is a discussion on sea water temperature change due to discharge. MIKE modeling studies have been carried out for a discharge of 43220 MLD with temperature not exceeding 7°C above the ambient level. And the report states that there is no issue in the discharged water 's temperature. The discharge will reach the ambient temperature within a shorter distance and time.[26]

CSE's Comment: The report often says the area has less fishing activity hence the impact on marine organisms will be low. The report ignores other marine organisms. There is no study made to predict the impact of the withdrawal of sea water in large quantity. Even though the report says that the discharge would reach ambient temperature before going into the sea. However there is no talk on how the temperature of sea water would drop low and if it would remain the same in all seasons. It looks more overlooking and consoling way of analysis rather than a firm scientific prediction.

C) Water Requirement: The total water requirement of the project is 43245 MLD and it is going to be sourced from the sea. The process wise water requirement for the turbine close loop system is estimated to be 7040 m^3 / hour (hr) and that of condenser system is estimated to be 282960 m^3 /hr for a single unit. Put together the 6 units of 1000 MWe would require 43200 MLD of sea water for its operation says the report.[27] Apart the project also proposes a 45 MLD desalination plant to meet the fresh water requirement of the township and freshwater requirement of the plant. The sea water will be withdrawn by a groyne type sea water intake.[28] And the report says that filters will be put on the intake to prevent the entry of fishes and larve.[29]

CSE's Comment: The impact on withdrawal of 43200 MLD of seawater is not discussed in the report.

D) Dredging: The proposal involves dredging activity. The quantity of dredging is estimated at 3 million cubic metre[30] and is proposed to be utilized onshore to raise the level of the plant area.[31] It also says that the dredge spoil will be dumped on shore by means of appropriate shore based and floating pipelines to create artificial bund along the shore and along the periphery to afford protection from any possible natural processes including Tsunami. However the report predicts adverse marine impacts on dredge spoil dumpage in sea and onshore.

Sea:

- Increase in turbidity level leading to reduced photosynthetic activity of the water column,
- Smothering problems on benthos and
- breathing problems for fishes.

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[26]Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg VIII

[27]Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 81 of 389

[28]Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg VIII

[29]Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg VIII

[30]Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 258 of 389

[31]Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg VIII

Onshore:

- Percolation of seawater and possible contamination with the ground water,
- Appropriate drainage system for letting water back into sea,
- Other possible issues, if any affecting land use in the neighborhood.

CSE's Comment: The report itself has identified the problem with dredge spoils. However no mitigation measure for the issue has been discussed.

E) R & R Plan: Land will be acquired from 340 khatedars for the construction of the project.[32] Three coastal villages of Mithvirdhi – Jaspara, Mandava and Khadapar are affected by the project. EIA report elaborates that the company will collaborate with the state government in identifying the affected people and will implement the R&R according to the state policy.[33]

CSE's Comment: No details on R&R plan has been discussed.

F) Waste Management:

i) Radioactive air waste management

The expected annual Average releases of airborne radionuclide are 1.1391 X 104 Ci/year.[34] The plant proposes an 'effective' air filter for filtration of radioactive nuclear waste.

ii) Radioactive liquid waste management plan

The expected generation of liquid radwaste will be 87.29 M3/year/unit.[35] The expected annual average of radioactive liquid effluents generated is given as

- Radioisotopes (other than tritium) 0.25623 Ci/Yr[36]
- Tritium Release 1010.0 Ci/Yr

The major categories of liquid radioactive wastes generated includes[37]

- borated, reactor-grade, waste water through the chemical and volume control system (CVCS),
- primary sampling system sink drains and equipment leak offs and drains, Floor drains
- and other wastes with a potentially high suspended solids content, collected from various building floor drains and sumps,
- Detergent wastes with very low concentrations of radioactivity from the plant hot sinks and showers, and some cleanup and decontamination processes
- and Chemical waste comes from the laboratory and other relatively small volume source

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[32] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg VI

[33] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 338 of 389

[34] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 81 of 389

[35] Curies/year

[36] Curies/year

[37] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 72 of 389

And the liquid waste in proposed to be treated using a pre filter, deep bed filter, ion exchange and after filter.[38]

CSE's Comment: The liquid radwaste system comprising filtration and ion exchange beds is not effective in removing tritium.[39] However it is the best available technology in place is the ion exchange filter for managing other radio nuclide in the waste. [40]

iii) Radio Active Solid waste management plan

Radioactive solid waste generated in the area includes,[41]

- Spent ion exchange resin[42]
- paper-waste
- cotton waste
- air filter
- liquid filter
- shoe covers
- hand gloves
- mops
- discarded clothing and components
- Sludge etc.

The expected generation of Wet and Dry rad waste are 21.66 m3/year/unit and 141.40 m3/year/unit respectively.[43] And the EIA report assures that the solid waste will be packed in sealed containers and will be disposed of in stone lined earth trenches, RCC vaults, tile holes and the radiation from these structures will be maintained less than 0.01 mGy/h and the safe limit is 0.05mSv/y.[44] And the report also mentions that an incinerator will be provided to combust low level radioactive waste.[45]

CSE's Comment: The way the EIA has compared mGy/h (milli gray per hour) with milli sievert per year seems vague. milli gray per hour is a unit used to measure radiation strength and milli sievert is a unit used to measure the effect produced on an individual due to the exposure to the gamma radiation. 1 mSv is the dose produced by exposure to 1 milligray (mG) of radiation.[46] 0.01mGy/h equals to 87.658 mSv/y, which is alarming compared to the safe limit 0.05mSv/y.[47]

Decay storage is the best available practice followed in many countries like U.K and U.S[48] for handling low level waste however the EIA report proposes to incinerate the waste.

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[38] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 72 of 389

[39] *https://www.ukap1000application.com/PDFDocs/Safety/UKP-GW-GL-026.pdf* as viewed on February 27, 2013

[40] *https://www.ukap1000application.com/PDFDocs/Safety/UKP-GW-GL-026.pdf* as viewed on February 27, 2013

[41] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 242 of 389

[42] Filtering material for radioactive waste

[43] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 87 of 389

[44] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 242 of 389

[45] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 87 of 389

[46] *http://www.mun.ca/biology/scarr/Radiation_definitions.html* as viewed on February 11, 2013

[47] 1 milligray/hour = 100 millirem/hour ; 1 millirem/hour = 87.658 millisievert/year Source:Google Calculator

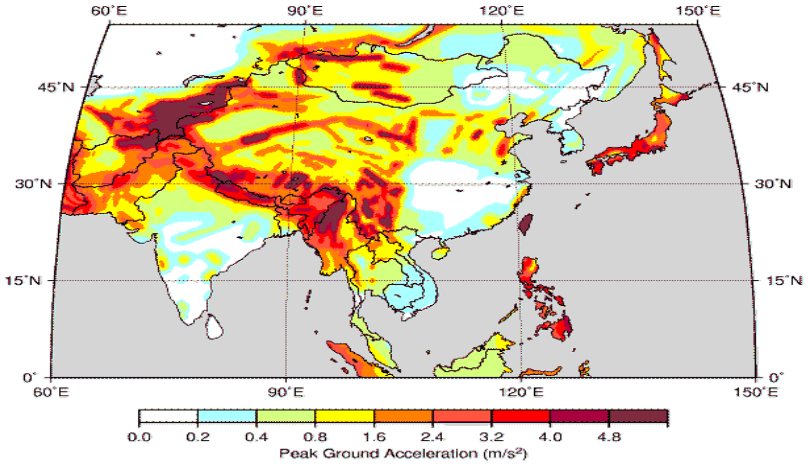
[48] *http://www.nda.gov.uk/documents/upload/UK-Strategy-for-the-Management-of-Solid-Low-Level-Radioactive-Waste-from-the-Nuclear-Industry-August-2010.pdf* as viewed on February 27, 2013

G) Hazard Management Plan

In case of a natural disaster the EIA report says the district collector and Special relief commissioner are responsible for giving remedy to the immediately affected people.[49] And it mentions that all precautionary measures have been considered while engineering the facility to meet any such natural disaster events.[50]

Earth Quake zone: The plant lies in Seismic Zone 3. The EIA report says that there is no risk of earthquake in the area since it is in Seismic zone 3 and hence does not discuss any hazard management scenario.[51]

CSE's Comment: But a global seismic hazard program of Eastern Asia shows that Fukushima and Bhavnagar area lies in the same risk zone.



Source: http://www.seismo.ethz.ch/static/GSHAP/eastasia/

In case of radiation leakage due to any reason due to the plant then the following strategy will be followed says the EIA report[52]

1. Iodine Prophylaxis administration
2. Sheltering
3. Evacuation
4. Decontamination
5. Control of food and water supplies
6. Use of stored animal feed
7. Decontamination of area

And the administrative procedure as to how it will be carried out is discussed in the flow chart below. Essentially the flow chart says there will be a unit called Emergency stand by unit and they will be responsible for resuming operations in the plant. And any hazard happening in the area should be informed to the plant operator by a group called

[49] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 305 of 389

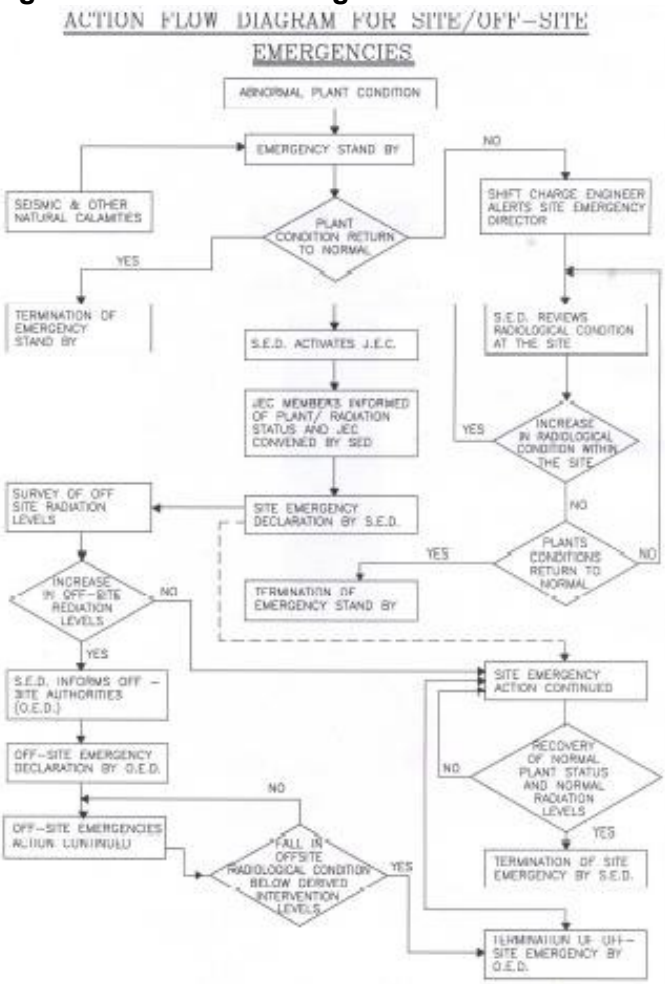
[50] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 305 of 389

[51] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 306 of 389

[52] Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 312 of 389

communication group in the plant.[53] The report also says that the emergency plans will be revised once in five years and mock exercises will be conducted in front of officials from Crisis Management Group, Department of Atomic Energy, Bhabha Atomic Research centre, Nuclear Power plant Corporation - head quarters [54]

Figure 1: Action flow diagram for site/ Off site emergencies[55]



CSE COMMENT: The agencies responsible for onsite/offsite emergencies are discussed in the EIA report as below, [56]

Type of Emergency	Responsible Agency	Literal Meaning
Emergency Standby	Plant/Site management	Failure of engineered safety in plant & locally the plant gets affected
Personnel Emergency	Plant/Site management	If a person working in the plant gets affected by radiation

[53]Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 312 of 389

[54]Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 316 of 389

[55]Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 318 of 389

[56]Engineers India Limited, New Delhi, *Environmental impact assessment report for nuclear power plant at Mithivirdhi, Bhavnagar, Gujara*t, pg 314 of 389

Type of Emergency	Responsible Agency	Literal Meaning
Plant Emergency	Plant/Site management	If the plant gets contaminated with radiation
Site Emergency	Plant/Site management	An accidental release of radioactivity extending beyond the plant but confined to the site boundary (exclusion zone-1km radius of plant) constitutes a site emergency.
Off-site Emergency	District authorities of the State Government having jurisdiction over the public domain affected by the accident, normally the District Collector	When public are affected.

Thus NPCIL takes no charge of providing a mitigation measure to the affected community in case of an off-site emergency. Also no details of what would happen, how it will be dealt with and who will be in charge of dealing with it in case of on-site emergencies is not clear.