**Introduction**

The current nuclear disaster at the Fukushima Daiichi Nuclear Power Plant (FD-NPP) in Fukushima, Japan raises concern over the siting and structural stability of nuclear reactors in the United States. The FD-NPP disaster was caused by an earthquake and the subsequent tsunami which ruined the facility’s cooling systems, causing partial melt downs and pressure concerns in both reactor vessels and the spent fuel pools. The area of the U.S. that raises the most concern for a potential nuclear disaster is the State of California due to its seismic activity and proximity to the ocean. Current and past nuclear reactor sites in the state will be evaluated for risk based on a number of factors. Additional locations for future reactors will be suggested based upon the risk map created. Regardless of the dangers that have presented themselves in Japan, and infamous historical accidents, it is still important to consider the future use of nuclear energy.

Nuclear energy lacks major carbon emissions when in operation, and with rising global climate change concerns, it is important to continue its consideration as a part of the United States’s future energy portfolio. Moving forward it will be important to locate sites in globally stable locations that will minimize risk and danger posed to the population.

Analysis revolved around the State of California, with the data included primarily from the state, however information from the surrounding states Oregon, Nevada, and Arizona was also included to provide more realistic models of density of certain features. The inclusion of data outside the state reduced edge effects in the density maps, and provided for a more accurate analysis. The first characteristic taken into account was the subsurface geology in the state. To do this a bedrock map was taken and reclassified based on geology into rock that could be built upon, and rock that is considered unstable (unconsolidated). This allowed for a first step, prior to additional ground testing.

The next step was to include the occurrence of earthquakes in the state. All earthquakes in the region since 1990 were mapped, and then a density using the magnitudes of the Earthquake’s was taken to show areas that are most frequently hit, and hit the hardest. Though a small earthquake would not necessarily produce damage it would require a reactor shutdown, stopping the production of power.

One of the important criteria the U.S.NRC considers in a selection of a reactor site is the potential for ground motion, which is quantified as an acceleration. Rather than using historical data, the USGS Earthquake Hazard’s Program “probability of exceedance” was used. Data produced for “Peak Ground Acceleration” for a chance of 10% in 50 years for a Vs = 337 m/s, a specific traveling speed. Data for the Western U.S. was extracted and then clipped to the California region. The data is provided as Latitude-Longitude points every 15 minutes with corresponding ground acceleration. The inverse distance weighted (IDW) interpolation method produced a clear map of the state showing zones of both high and low ground motion.

**Method**

Data for all currently mapped faults in the state was taken into account. The faults in the state are shown mapped, as building a reactor site on top of a current known fault is not accepted by the U.S.NRC. In addition a density plot of all faults in the state is shown as building in these areas is not desirable because of the greater chance of locating a currently non-document fault. Jurisdictional dams operated within the state were also taken into consideration, by using the density of dam locations. The more dams in the area, the larger the concern of one break becomes because of a potential chain reaction down a river.

Mines in the state were then taken into account. Mine locations in the state were given both a 1 and 5 mile buffer, which were scaled with 75% and 25% importance respectively.

To include population, a density raster of the population of counties as of the 2000 census was used. Transportation was included using a map of all major roads in the area and providing a 20 mile buffer. This allows for easy enough access with our requiring long access roads. Though an access road with restrictive access would be required, there is a maximum length of an access road should be.

After quantifying all major requirements made by the U.S.NRC by creating scaled raster maps of the State of California, it is important to consider the proximity of past & current nuclear reactor sites, and as well as suggest regions for future sites. To do this, all of the raster maps were combined into one risk map, with each of the factors weighted appropriately. The results of this analysis are shown at right.

**Summary of Site Selection Criteria**

- **Nuclear Occurrences & Features**
  - Subsurface Geology
    - Must be consolidated bedrock
  - Earthquakes
    - Fewer earthquakes reduces the chance of ground motion
  - Ground motion
    - Low ground motion is ideal to reduce necessary building specifications
  - Faults
    - Do not want to build on faults incase of movement

- **Man-made geological changes**
  - Dams
    - Catastrophic failure could lead to large flooding issues at reactor site
  - Mines
    - Potential to generate faults and vibrations not accounted for in natural geology

- **Infrastructure**
  - Population
    - Need enough distance for safety, but want to reduce transmission distance
  - Transportation
    - Require good access for construction and possible emergency services

**Results**

As part of the method, all of the raster maps were normalized to their maximum, so that all maps had a value range from 0 to 1, with 0 being the most desirable and 1 the least desirable for each of the criteria. With this normalization the different units of each map could be disregarded in the creation of the final risk map. The final map created was done by using map algebra and creating what is believed to be an appropriate conjunction of all of the parameters.

**Sources**