

# Radiation Tolerance of Model 711 Ultra Precision Tilt Sensor



- **Objectives:** Monitor foundation in irradiated environment
- **Solution:** **Model 711 Ultra Precision Tilt Sensor**
- **Benefits:** High resolution, durable, radiation resistant
- **Results:** Reliable monitoring with shielding electronics

## Project

The Ascó nuclear power plants Unit I and Unit II are located in the town of Ascó, in the district of Ribera d'Ebre in the province of Tarragona. Cooling for both units is provided by the Ebro River. Authorization for construction of Ascó Unit I was granted by what was then the Ministry of Industry and Energy (MINER) in 1974, and the other unit was authorized in 1975. The right to use the cooling water was awarded in 1977. After the operation permit was granted by MINER in 1982, the first unit was connected to the grid in 1983, followed by the second in 1985.

The integration of the site into its surroundings was achieved by building confidence in the reliability and safety of its operation over the years, as well as by collaborating in activities of general interest promoted by local cultural and sports associations. The land around the plant (and owned by it) has been used to cultivate vines, olives, fruit, etc.

In order to make the plant's activities and nuclear power in general more accessible to society, Ascó opened a new interactive information center that is open to the public in November 2011.

The Ascó II nuclear power plant went into commercial operation on March 31, 1986. The Ascó II Gross accumulated production from source through May 31, 2023 was 287,029,010 MWh. The Monthly production in May 2023 was 771,210 MWh and accumulated production for the year was 3,757,530 MWh

During 2022, the gross electric energy production corresponding to unit II was 7,933.71 GWh. From the start of its commercial operation in March 1986 until December 31 2022, it has accumulated 283,271.48 GWh. That same year, the gross energy production generated by both units at the Ascó nuclear power plant was 16,811.37 GWh.



Jewell Instruments [Model 711 Ultra Precision Tilt Sensor](#)



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In 1987 a Jewell Instruments large tilt metering system was delivered to the Ascó 2 nuclear power plant for monitoring of foundation stability. As part of the acceptance process, four surface mount tiltmeters – Models 711 and 712 – were subjected to accelerated aging tests in a radiation sterilization facility in southern California. The sensors in these tiltmeters are representative of all of the sensors used in our 500-, 700- and 800-Series tilt sensing products.

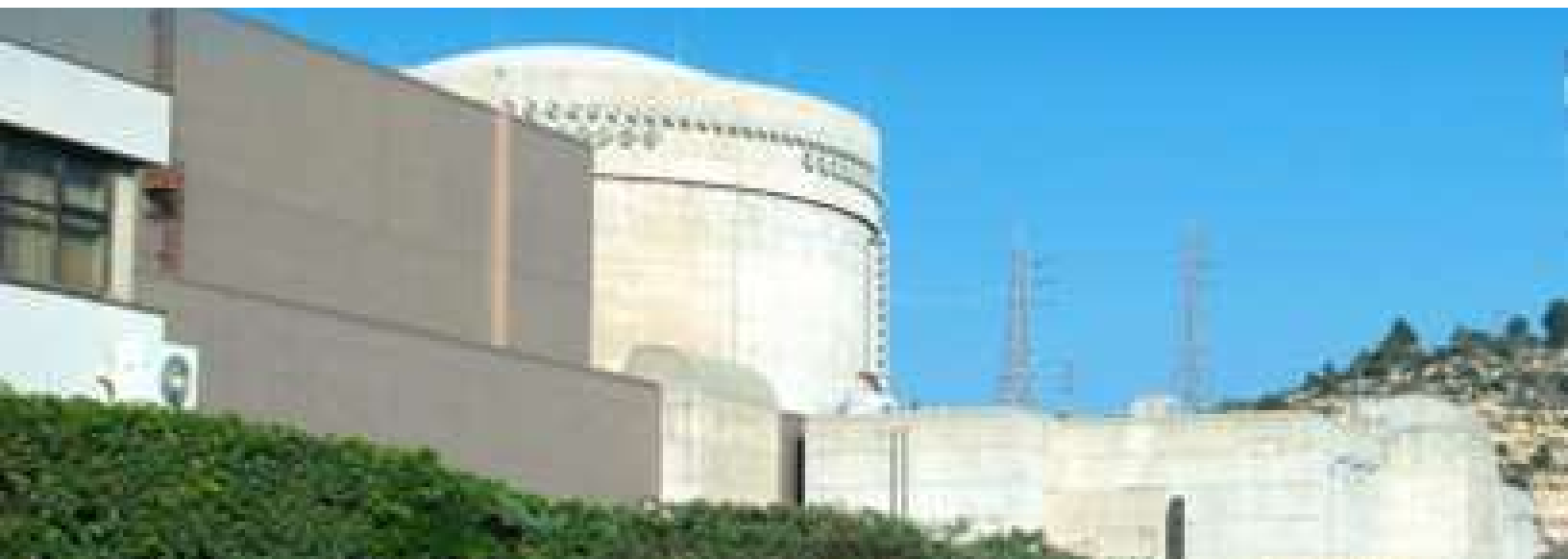
The tiltmeters were dosed with 0.36 to 9.76 megarads of gamma radiation from a cobalt 60 source. The dose rate was approximately 0.08 megarads/hour. The four tiltmeters were powered up during the testing and their output signals were recorded on instruments outside of the radiation chamber. The tests revealed the following:

- The integrated circuits on the printed circuit assemblies in the tiltmeters failed from radiation damage

within one hour of the start of irradiation.

- Resistors and most capacitors continued to function after 9.76 megarads of irradiation.
- After irradiation was completed the damaged electronics were replaced with new electronics. The electrolytic tilt sensors in the units were then operated. The sensors appeared to function normally and to be undamaged even after 9.76 megarads of irradiation.

The model A711-2 (floor-mount), and A716-2 (wall-mount) bolt or clamp to any surface and are well suited for areas with heavy traffic or vibration. Electronic performance is identical to the model A701-2. Floor-mount models are available with a weatherproof NEMA 4X seal (A711-2 4X), or with an RS-232, RS-422, or RS-485 digital output (D711). D711 units also include on-board memory with a storage capacity of up to 22,000 samples. Units include two switchable gains and two low-pass filter settings and are sensitive to <math><0.1 \mu\text{rad}</math>.



Applications of the [700 Series Tiltmeter](#) include volcano monitoring, high-precision geotechnical engineering, bridge deflection monitoring, precision metrology, radar platform leveling, and high-accuracy tilt monitoring applications where bolt-on installations are required.

These results indicate that Jewell Instruments electrolytic tilt sensors will perform successfully in high-radiation environments. However, the signal conditioning electronics necessary to operate the sensors will experience radiation damage. When tilt measurements must be made under radiation conditions, the solution is therefore to 1) shield the signal conditioning electronics or 2) locate the electronics in an area that is not irradiated. In the latter case the tilt sensors and electronics are connected by wires that may be up to 100 meters long.

## About Jewell Instruments

Jewell Instruments is a world leader in the design, manufacture, and distribution of high-precision products. Our expertise includes acceleration and tilt sensors, electronic compasses, avionics components, solenoids, and panel meters. The extensive application knowledge we have obtained through decades of experience allows us to provide custom solutions for a diverse group of industries. In fact, customers from all over the globe contact us for solutions to aerospace, medical, industrial, and telecommunications applications - to name a few.

To find out more, visit our website!



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