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PREDICTION OF SEAWEED INGRESS INTO COOLING WATER INTAKES FOR TORNESS POWER STATION

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Seaweed ingress into the cooling water intakes of nuclear power stations has caused several disruptions to electricity supply in the last decade. We consider the Torness power station on the eastern coast of Scotland where the surrounding region is rocky and populated with different species of seaweed including kelp and red algae. Seaweed is transported by tidal and wave-induced currents after dislodgement from the sea bed after stormy conditions. By means of a statistical analysis of offshore wave buoy data, we show that wave conditions alone are not sufficient to determine whether ingress will occur. To account for the additional processes required, an integrated model system has been developed combining coastal tidal current and wave simulation using the TELEMAC-2D and TOMAWAC open-source software. A new approach for seaweed dislodgement and transport has been developed to predict seaweed ingress into the cooling water intake. This was applied at Torness where the mass of seaweed recovered had been measured for multiple ingress cases. In the model, prior to each case, initially seaweed is assumed to be distributed within the surrounding coastal domain with a mass per unit area based on local survey measurements. Criteria for dislodgement are based on near-bed threshold velocities. We investigated eight cases, six where the mass of ingress was measured and two cases with no ingress. The model can predict whether seaweed ingress will occur or not in the cooling water intake providing valuable insight into the conditions leading to a partial power station shutdown.