Recently developed Reduced Activation Ferritic Martensitic (RAFM) ODS steels on the basis of the European RAFM reference steel Eurofer 97 showed good tensile and creep properties, acceptable ductility, but poor impact behavior. Selecting a specific production route for ODS-Eurofer steel of the second generation, which included rolling and appropriate thermal treatments, DBTT could be shifted from values between $+60$ and $+100^\circ C$ for hipped ODS-Eurofer of the first generation to values between -40 and -80$^\circ C$. Basing on this experience a 50 kg batch was produced and characterized. Numerous heat treatment experiments were performed to study their influence on mechanical properties and microstructure. While the tensile properties of this so-called EU ODS-Eurofer batch are comparable or slightly better than of the precursor alloy, the impact behavior is worse.

Analytical and structural TEM investigations of the samples from the EU ODS-Eurofer batch show the formation of new type of inclusions with Fe-Cr-V-O composition and a size of 40nm - 250nm. It was found that the inclusions are arranged in lines, which stretch out possibly on several tens of micrometers, independently from grain structure. These lines could represent prior austenitic grain boundaries or the grain boundaries of the initial steel powder particles. The application of high resolution TEM, and analytical methods such as electron energy loss spectroscopy (EELS), and energy dispersive X-ray (EDX) analysis, shows that these particles consist of a $(\text{Mn,Fe})(\text{Cr,V})_2\text{O}_4$ phase. This oxide phase usually forms on the surface of martensitic specimens during corrosion experiments. The degradation of impact properties might be attributed to the presence of these rows of large oxide inclusions, which may ease crack initiation and propagation.

The possible origin of these oxides might be the internal oxidation of the powder in the course of the fabrication process. The oxygen absorbs on the surface of powder particles and enables the formation of large oxide particles during mechanical alloying. This effect is well known in the Al containing ODS alloys such as PM 2000.