In this work H₂ electrode supported solid oxide cells (SOC) produced at Risø National Laboratory, DTU, have been used for steam electrolysis. Electrolysis tests have been performed at temperatures from 650°C to 950°C, p(H₂O)/p(H₂) from 0.99/0.01 to 0.30/0.70 and current densities from -0.25 A/cm² to -2 A/cm². The solid oxide electrolysis cells (SOEC) have been characterised by iV curves and electrochemical impedance spectroscopy (EIS) at start and end of tests and by EIS under current load during electrolysis testing. The tested SOCs have shown the best initial electrolysis performance reported in literature to date. Area specific resistances of 0.26 Ωcm² at 850°C and 0.17 Ωcm² at 950°C were obtained from electrolysis iV curves. The general trend for the SOEC tests was: 1) a short-term passivation in first few hundred hours, 2) then an activation and 3) a subsequent and underlying long-term degradation. The transient phenomenon (passivation/activation) was shown to be a set-up dependent artefact caused by the albite glass sealing with a p(Si(OH)₄) of ~1-10⁻⁷ atm, leading to silica contamination of the triple-phase boundaries (TPBs) of the electrode. The long-term degradation for the SOECs was more pronounced than for fuel cell testing of similar cells. Long-term degradation of 2%/1000 h was obtained at 850°C, p(H₂O)/p(H₂) = 0.5/0.5 and -0.5 A/cm², whereas the degradation rate increased to 6%/1000 h at 950°C, p(H₂O)/p(H₂) = 0.9/0.1 and -1.0 A/cm². Both the short-term passivation and the long-term degradation appear mainly to be related to processes in the H₂ electrode. Scanning electron microscopy micrographs show that only limited changes occur in the Ni particle size distribution and these are not the main degradation mechanism for the SOECs. Micro and nano analysis using energy dispersive spectroscopy in combination with transmission electron microscopy (TEM) and scanning TEM reveals that glassy phase impurities have accumulated at the TPBs as a result of testing of the SOECs. The impurities are typically in the size of 50-500 nm. The impurities are silicates, alumina silicates and in some cases sodium alumina silicates. It is believed that the degradation of the SOECs relates strongly to these impurity phases.