# Development of the test program and the assembly fixture for the nuclear fuel design TRITON11™

*A test program to test the mechanical performance and limits of the new nuclear fuel design TRITON11™ has been developed. To assemble the test fuel a fixture was constructed to be used at the laboratory.*

The engineers at Westinghouse Electric Company have developed a new fuel design called TRITON11™, which will be used in the Boiling Water Reactor (BWR). The new design is revolutionary compared to earlier BWR fuels designed by Westinghouse.

The design needs to undergo a lot of tests to ensure that it full fills the safety requirements established by governments and customers. If it doesn't the consequences could be catastrophic. This thesis has been to establish a scoping test program which describes what tests to perform and why. The purpose of the scoping test is to check the limits of the design regarding the mechanical performance. The test will be performed under reactor like conditions with two-phase flow. This means that the flow consists of water and vapor which is used to test the middle to upper parts of the design.

The program that has been developed tests a number of different critical aspects. One of these is fretting on the fuel rods from the spacers. This is known as grid-to-rod fretting wear and is caused by vibrations. A spacer is a metal grid which is used to hold the fuel rods firmly and at a defined distance from each other. If the fuel rods are not held firmly by the spacer they will start to vibrate and fretting can occur, which in time can lead to fuel failure.

To perform the tests planned in the program the fuel needs to be assembled. The assembly will be done at the fuel laboratory and to do so a fixture is needed. The purpose of the fixture is to hold the spacers at the right distance from each other and to hold the bottom plate of the fuel. Once all the rods are in place the handle is assembled and the fuel is lifted out of the fixture. The TRITION11™ fuel comes in two different designs called the Nordic and the Continental design. They are quite similar but the Continental is a bit longer and the bottom/top part differs slightly from the Nordic. Both fuel designs can be assembled in the fixture.

The fixture that was designed allows the spacers to be easily adjusted in the vertical direction by using screws and nuts. The corners of the fixture consist of an aluminum profile in which the T-slot nut is inserted. The screw joint fastens the spacer holder to the corner frame at the defined position. The bottom plate of the fuel is placed in a holder made of POM. The holder is designed to fit both the Nordic and the Continental bottom plate. The four corners of the fixture are held together by L-shaped steel bars at six different positions. The design of the fixture is kept simple to reduce the cost. The fixture is over 4 meters long and can be seen in the figure to the right.

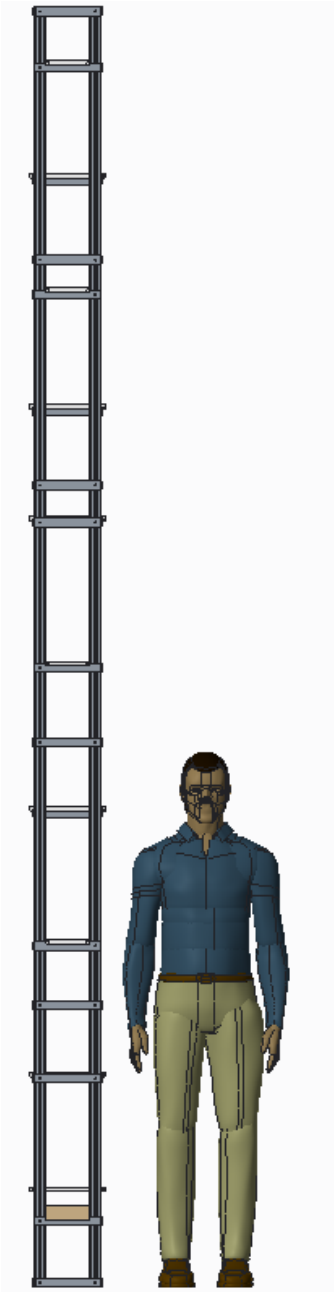

**Figure 1 The final design of the assembly fixture in comparison to an adult male.**