# The Evolution of Fusion High Power Density

## February 1997, San Diego

**For experimental devices like ITER, LHD, NSTX and LAR-VNS, we did not worry about neutron wall loading. We felt that the high divertor surface heat flux of about 30 MW/m$^2$ could be handled by sub-cooled flow boiling of water.**

**For conceptual reactor designs like ARIES-RS and GA-LAR we reported neutron wall loadings of 4 to 8 MW/m$^2$.**

**We noted the difficulties in the handling of disruption, run-away electrons and type-I ELMs.**

## October 1997, Sendai

**We considered devices like FFHR, Dream, SSTR, GALAR and ST-VNS with neutron wall loadings in the range of 1.5 to 8 MW/m$^2$, and divertor heat flux of 2 to 10 MW/m$^2$.**

**Divertor and core radiation are proposed to distribute the transport power to the plasma chamber.**

**ALPS program presented the grand challenge of having the goal of handling neutron wall loading in the range of 5-20 MW/m$^2$ and peak heat flux of up to 50 MW/m$^2$.**

**APEX has a goal of peak neutron wall loading of 7 MW/m$^2$, a peak first wall heat flux of 1.5 MW/m$^2$, with the suggested fusion goals of neutron wall loading >10 MW/m$^2$ and to minimize the peak to average power density.**

## February 1999

**APEX indicated goals of peak neutron wall loading > 10 MW/m$^2$ and surface heat flux > 2 MW/m$^2$.**

**JAERI demonstrated removal of surface heat flux of 20 MW/m$^2$ for 10 seconds for 1000 cycles.**

## February 2000

**At the peak neutron wall loading of 10 MW/m$^2$, APEX/EVOLVE shows a peak nuclear heating of 100 MW/m$^3$ on the W-alloy and about 30 MW/m$^3$ on the lithium.**

**The additional consideration is the actinide burn devices with neutron wall loading in the range of 1 to 3 MW/m$^2$ and blanket energy multiplication in the range of 10 to 30. These could have a peak and average blanket power density of 100 MW/m$^3$ and 60 MW/m$^3$, respectively, in the blanket material.**

**Note that we still have not addressed the issues in the handling of disruption, run-away electrons and type-I ELMs.**