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### **Residual Stress Analysis for Industry Using Neutron Scattering at Oak Ridge National Laboratory**

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Oak Ridge National Laboratory is home for two of the highest flux neutron sources in the world: the High Flux Isotope Reactor, HFIR, and the Spallation Neutron Source, SNS. Two engineering materials science instruments have been built - NRSF2 at HFIR began operation in 2006 and VULCAN at SNS began commissioning in late 2009. The instrument at HFIR is called NRSF2 as it is the 2nd generation Neutron Residual Stress mapping Facility. It is primarily used for high spatial resolution diffraction mapping of residual stresses throughout the thickness of samples and for measurement of material behavior during in situ and/or real-time processes. NRSF2 is extensively used by industry as well as academia for non-destructive stress and phase mapping through thickness of actual components as well as mock-ups. designed for testing FEA models of processes. Examples of studies from the vehicle technologies industry and nuclear power industry conducted at NRSF2 will be presented. These include studies of stresses due to welding, heat-treating, casting, and metal forming. Many strain/stress mapping studies at NRSF2 are used to optimize materials processes such as welding or to test validity of FEA models. Examples of industrial projects with Caterpillar on changes in weld metal to improve fatigue life, John Deere to test and validate casting models, Metalsa-Roanoke to characterize stress distribution about holes in steel vehicle frames, and EPRI to test and validate models of residual stresses about dissimilar metal welds. Industry-University collaborations have used the mapping facilities to study in situ such phenomena as the state of charge in Li-ion batteries and the critical bend stress in gears as a function of loading. Three different collaborative routes are available to industry to use NRSF2: the HTML User Program, which is sponsored by DOE-EERE-Vehicle Technologies; DOE Cooperative Research and Development Agreements (CRADAs); and industry sponsored projects.