# *NUCLEAR ENERGY UNIVERSITY PROGRAMS*

## Thermodynamic Development of Corrosion Rate Modeling in Iron Phosphate Glasses

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**Abstract**

Additional research is necessary to develop alternative waste forms for immobilizing radionuclides found in high-level nuclear waste (HLW) streams. One of the leading candidate alternative waste forms is glass based on mixtures of iron and phosphate oxides. These "iron phosphate" glasses have numerous advantages over the borosilicate glass currently used as the "standard" fixation medium for HLW, which may lead to their selection as a supplement or replacement medium. This project provides a science–based approach for the development and prediction of performance of such waste forms.

The development of a method for predicting corrosion rates in iron phosphate glasses involves two primary research efforts. The first is improvement of the database of measured corrosion rates in these glasses, and the second is generating sufficient thermodynamic data to calculate $\Delta G_{hyd}$ in phosphate glasses. Key project milestones are as follows:

- Experimental measurements of the entropy and room–temperature heat capacity values of iron phosphate compounds.
- Measurement of high–temperature heat capacity of an iron phosphate compound.
- Corrosion rate measurements of iron phosphate glasses
- Demonstration of the use of acid–solution calorimetry to reproduce experimentally determined values of $\Delta H°$ for an anhydrous phosphate
- Experimental determination of $\Delta H°$ for five iron phosphate compounds
- A model correlating the corrosion rate of iron phosphate glasses with controllable variables (Fe/P and $Fe_2+/Fe_3+$ ratios).