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A borehole radar tomography experiment was conducted at the Yucca Mountain potential nuclear waste storage facility in Nevada. The intent of this experiment was to investigate the use of high resolution, time-lapse tomographic radar data for studying moisture migration that occurs within the rock mass as a result of the dramatic increase in rock temperature during a heater test. The extreme sensitivity of the radar response to even very slight changes in water saturation suggested the suitability of this technique. However, temperature also affects the radar response. Petrophysical relationships developed using laboratory measurements and calibrations of field data were necessary to separate out the effects of saturation and temperature on the radar response prior to saturation estimation. These relationships were developed using three different approaches including: 1) linear regression and 2) artificial neural network techniques on laboratory measurements, as well as 3) regression techniques on field tomographic radar data and borehole logs. We will present the three different methodologies used to develop the petrophysical relationships, as well as the saturation estimates obtained using time-lapse tomographic radar data together with these relationships. The information supplied by these data are necessary for understanding and predicting the influence of the stored radioactive waste at the potential nuclear waste facility.