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Report Title: Behavior of a Corium Jet in High Pressure Melt Ejection From a Reactor Pressure Vessel

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Instructions: Please replace the unnumbered Introductory page with the attached corrected one.

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1. INTRODUCTION

1.1 Background and Objective

In the event of certain postulated core meltdown accidents in light water reactors, part of the reactor fuel, fuel cladding, and internal structures will melt and slump into the lower plenum of the reactor pressure vessel (RPV). This material, if still molten, could be discharged from the RPV as a high velocity jet if an in-core instrumentation tube penetration fails and if the primary system pressure is significantly above containment pressure. Probabilistic risk assessment studies have concluded that, although of low total probability, high-pressure accidents would dominate risk for pressurized water reactors (PWRs).

The in-vessel phenomena of a severe accident are currently being studied through intensive research and computer modeling such as the MELPROG project.[1] In this study, we are mainly interested in the final stage of the in-vessel accident progression, namely vessel failure and melt transport from the RPV to the containment building. Our attention is limited to the PWR, which means that molten material, often called corium, will be released from the reactor vessel to the reactor cavity region.

The amount of melt, its composition, temperature, and content of dissolved gases, as well as the primary system pressure and temperature at the instant of vessel failure, is dependent on the prior events of the accident. The detailed analysis of the accident initiating events and of various accident sequences is carried out in a probabilistic manner. Well-known examples of such studies are the WASH-1400 report[2] and Zion Probabilistic Safety Study (ZPSS).[3]

For our purpose, it is enough to note that in-vessel accident progression and vessel failure can occur under various pressures in the primary system, ranging between 0.1 MPa and full system pressure, i.e., about 17 MPa.

If the accident is initiated by a large break of one of the reactor cooling circuits, the primary system pressure will rapidly decrease and eventually come to equilibrium with containment pressure. However, if the accident is initiated by the small break or transient event, the primary system pressure may be above that of containment at the time of vessel melt through. How the accident is initiated needs to be known to determine how the corium will be relocated from the reactor vessel to the reactor cavity and the subsequent cavity phenomena.

We can distinguish between two modes of corium transport in this connection; so-called gravity drop when the primary system pressure is equal to the containment pressure, and

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