From: Dennis Galvin
To: Tae Ahn
Date: 8/11/04 10:14AM
Subject: Fuel Disolution

Tae,

I reviewed the TPA 4.0 manual. Equations 8-9, 8-10, and 8-12 are the equations governing fuel disolution models 1, 2, and 4. The equations do not include the flow rate. This will result in some scenarios with rapid disolution of the fuel even when there is little or no water dripping in and flowing through the waste package. Therefore changing Fmult will not affect the quantity of radionuclides available for release, even though intuitively limited dripping water should affect the fuel disolution rate.

The base case model (2), simulates a loguniform disolution rate sampled between 0.01 and 10 mg/m2d. I am not sure how to convert this to frac/d so I can compare it to high and low drip rate data.

The manual states that geometrical effects inside the waste package have been essentially been ignored to simplify the models. This introduces an important distortion to the results. DOE will be inserting neutron absorbing plates designed to last beyond a 10,000 year compliance period. These plates may divert dripping water from contacting most of the fuel for the length of the compliance period (the fuel assemblies at the top of the waste package would not be protected).

If a probalistic analysis were done for fuel dissolution similar to that proposed for criticality, high releases from the waste package should have a similar probability and should have a similarly low risk significance since many similar internal processes would need to occur (significant holes in the waste package, significant water passing through the holes, degradation of the neuton absorbing plates). However, since current models for the most part ignore internal processes, dissolution appears unrelated to flow, and large releases which are not mechanistic can result.

Please assist me in better correlating currently modeled disolution rates with drip rates. Also if I have misinterpreted the dissolution models or drawn the wrong conclusions let me know.

Thanks,

Dennis

CC: Andy Campbell; Bret Leslie; Marissa Bailey; Richard Codell

From: Dennis Galvin
To: Osvaldo Pensado
Date: 8/11/04 10:39AM
Subject: Re: Fuel Disolution

Osvaldo,

Part of my consternation in writing on criticality concerns is that processes that need to occur for rapid fuel dissolution and large releases are simliar to those required for criticality events. However, do to simplications in the TPA modeling, these processes are for the most part ignored (see below). I am working with Tae to verify that the effects are as big as I am postulating. If you can point out errors in my logic I would appreciate it. I am pursuing this in part since if the arguments against criticality events are true, many of the things we classify as high risk significance are really medium or low and should be acknowledged.

Thanks,

Dennis

>>> Dennis Galvin 08/11/04 10:14AM >>>
Tae,

I reviewed the TPA 4.0 manual. Equations 8-9, 8-10, and 8-12 are the equations governing fuel disolution models 1, 2, and 4. The equations do not include the flow rate. This will result in some scenarios with rapid disolution of the fuel even when there is little or no water dripping in and flowing through the waste package. Therefore changing Fmult will not affect the quantity of radionuclides available for release, even though intuitively limited dripping water should affect the fuel disolution rate.

The base case model (2), simulates a loguniform disolution rate sampled between 0.01 and 10 mg/m2d. I am not sure how to convert this to frac/d so I can compare it to high and low drip rate data.

The manual states that geometrical effects inside the waste package have been essentially been ignored to simplify the models. This introduces an important distortion to the results. DOE will be inserting neutron absorbing plates designed to last beyond a 10,000 year compliance period. These plates may divert dripping water from contacting most of the fuel for the length of the compliance period (the fuel assemblies at the top of the waste package would not be protected).

If a probalistic analysis were done for fuel dissolution similar to that proposed for criticality, high releases from the waste package should have a similar probability and should have a similarly low risk significance since many similar internal processes would need to occur (significant holes in the waste package, significant water passing through the holes, degradation of the neuton absorbing plates). However, since current models for the most part ignore internal processes, dissolution appears unrelated to flow, and large releases which are not mechanistic can result.

Please assist me in better correlating currently modeled disolution rates with drip rates. Also if I have misinterpreted the dissolution models or drawn the wrong conclusions let me know.

Thanks,

Dennis

CC: Darrell Dunn; Tae Ahn; Vijay Jain

From: Osvaldo Pensado <opensado@cnwra.swri.edu>
To: "'Dennis Galvin'" <DJG3@nrc.gov>
Date: 8/11/04 11:15AM
Subject: RE: Fuel Disolution

The correlation to flow is in Equation (8-1). Radionuclides leach into water inside the WP, and this water will leave the WP and transport radionuclides away. The higher the flow rate (outward flow), the more radionuclides you will transport away. The upper bound in this release rate from the EBS is given by the spent fuel dissolution rate. In other words

Release Rate EBS <= Release Rate SF at waste surface

The equality is obtained in the limit of high flow rate or high solubility.

The release from the SF surface is activated after failure of the WP. Release away from the EBS can only occur after failure of both the WP and drip shield.

SF release at the SF surface is not related to flow; however, EBS release IS related to flow. For example, if you set the flow equal to zero in the TPA, you will see that there is no release from the EBS.

We believe that our SF leaching rate model is relatively conservative, because it is based on empirical data to measure forward dissolution reaction rates (i.e., backward "precipitation" reaction rates are disregarded).

Can criticality enhance the dissolution rates?

-----Original Message-----
From: Dennis Galvin [mailto:DJG3@nrc.gov]
Sent: Wednesday, August 11, 2004 9:40 AM
To: OPENSADO@cnwra.swri.edu
Cc: DDUNN@cnwra.swri.edu; VJAIN@cnwra.swri.edu; Tae Ahn
Subject: Re: Fuel Disolution

Osvaldo,

Part of my consternation in writing on criticality concerns is that processes that need to occur for rapid fuel dissolution and large releases are simliar to those required for criticality events. However, do to simplications in the TPA modeling, these processes are for the most part ignored (see below). I am working with Tae to verify that the effects are as big as I am postulating. If you can point out errors in my logic I would appreciate it. I am pursuing this in part since if the arguments against criticality events are true, many of the things we classify as high risk significance are really medium or low and should be acknowledged.

Thanks,

Dennis

>>> Dennis Galvin 08/11/04 10:14AM >>>

Tae,

I reviewed the TPA 4.0 manual. Equations 8-9, 8-10, and 8-12 are the equations governing fuel disolution models 1, 2, and 4. The equations do not include the flow rate. This will result in some scenarios with rapid disolution of the fuel even when there is little or no water dripping in and flowing through the waste package. Therefore changing Fmult will not affect the quantity of radionuclides available for release, even though intuitively limited dripping water should affect the fuel disolution rate.

The base case model (2), simulates a loguniform disolution rate sampled between 0.01 and 10 mg/m2d. I am not sure how to convert this to frac/d so I can compare it to high and low drip rate data.

The manual states that geometrical effects inside the waste package have been essentially been ignored to simplify the models. This introduces an important distortion to the results. DOE will be inserting neutron absorbing plates designed to last beyond a 10,000 year compliance period. These plates may divert dripping water from contacting most of the fuel for the length of the compliance period (the fuel assemblies at the top of the waste package would not be protected).

If a probalistic analysis were done for fuel dissolution similar to that proposed for criticality, high releases from the waste package should have a similar probability and should have a similarly low risk significance since many similar internal processes would need to occur (significant holes in the waste package, significant water passing through the holes, degradation of the neuton absorbing plates). However, since current models for the most part ignore internal processes, dissolution appears unrelated to flow, and large releases which are not mechanistic can result.

Please assist me in better correlating currently modeled disolution rates with drip rates. Also if I have misinterpreted the dissolution models or drawn the wrong conclusions let me know.

Thanks,

Dennis

CC: <DDUNN@cnwra.swri.edu>, <VJAIN@cnwra.swri.edu>, "'Tae Ahn'" <TMA@nrc.gov>