Table A-7
Evaluation of Environmental Releases for Indian Point Sequence V

| Time | Event Sequence | Expected Behavior of Cs-Rb | Fraction of Core Inventory in Auxiliary Bldg | Fraction of Core Inventory Released to Environment[a] | Explanation of Reasoning |
|---|---|---|---|---|---|
| 0 to few minutes | RHR check valves fail leading to break in 6" line, system depressurizes dumping large amounts of steam and water into Auxiliary Building. | Only the RC FP inventory is involved at this point and most of this will remain in the liquid. | negligible | negligible | No core damage at this point. |
| 10 min to 30 min | Core uncovery begins and core heats up. Release pathway is through upper plenum and hot leg to Auxiliary Building. | Gap release (5%) plus an additional 20% of Cs expected to be released prior to melting. Expect DF of at least 10 by plate-out on upper plenum and by retention in condensing steam in Auxiliary Building. Treat Aux Bldg as breathing inward due to condensing steam. | 2.5E-02 | negligible | Core release from IPPSS and EPRI/IDCOR studies. Major removal by turbulent deposition in RHR line and gravitational sedimentation in Auxiliary Building. |
| 30 to 60 min | Core melting occurs, release pathways as above. | Remainder of Cs released during this period. Expect same DF of 10 or more. Auxiliary Building continues to breathe inward. | 1E-01 | negligible | See previous entry. |
| 60 to 70 min | Molten core falling into bottom head of RPV--vessel attack occurring. Release pathway as above. | Expect all Cs to have been released previously. | 1E-01 | negligible | See above. |
| 70 to 90 min | RPV bottom head collapses, corium drops onto dry concrete floor and core/concrete interaction begins. Releases are to intact containment. | No Cs left to be released. Any which is left and released at this point will be released to intact containment and a negligible amount will find its way back through the breach in the RPV. Auxiliary Building continues to breathe inward and airborne concentration in Auxiliary Building should drop by at least a factor of two. | 5E-02 | negligible | Dominant removal process in Auxiliary Building gravitational setting. |
| 90 min to 4 hour | Auxiliary Building begins to breathe with turnover time of about 4 hours. | Airborne material in Auxiliary Building continues to settle out providing effective DF of about 5. | 1E-02 | 7E-03 | CSE data would suggest DF greater than the factor of 5 used. |
| 4 to 12 hr | Auxiliary Building continues to breathe with turnover time of about 2 hours. | Airborne material continues to settle out with DF of about 5. | negligible | 1E-02 | Make consecutive assumptions that all airborne material at 4 hours is released over the next 8 hours. |

Table A-8
Evaluation of Environmental Releases for Indian Point Sequence V

| Time | Event Sequence | Expected Behavior of Kr-Xe | Fraction of Core Inventory | | Explanation of Reasoning |
|---|---|---|---|---|---|
| | | | In Auxiliary Bldg | Released to Environment[a] | |
| 0 to few minutes | RHR check valves fail leading to break in 6" line, system depressurizes dumping large amounts of steam and water into Auxiliary Building. | Only the RC FP inventory is involved at this point and most of this will remain in the liquid. | negligible | negligible | No core damage at this point. |
| 10 min to 30 min | Core uncovery begins and core heats up. Release pathway is through upper plenum and hot leg to Auxiliary Building. | Gap release (3%) plus an additional 20% of noble gases expected to be released prior to melting. Treat Auxiliary Building as breathing inward due to condensing steam. | 2.3E-02 | negligible | Core release from IPPSS and EPRI/IDCOR studies. No removal mechanisms operative except volumetric holdup. |
| 30 to 60 min | Core melting occurs, release pathways as above. | Remainder of NG released during this period. Auxiliary Building contines to breathe inward. | 1E00 | negligible | See previous entry. |
| 60 to 70 min | Molten core falling into bottom head of RPV--vessel attack occurring. Release pathway as above. | Expect all NG to have been released previously. | 1E00 | negligible | See above. |
| 70 to 90 min | RPV bottom head collapses, corium drops onto dry concrete floor and core/concrete interaction begins. Releases are to intact containment. | No NG left to be released. Any which is left and released at this point will be released to intact containment and a negligible amount will find its way back through the breach in the RPV. Auxiliary Building continues to breathe inward. | 1E00 | negligible | No removal mechanisms operative except volumetric holdup. |
| 90 min to 4 hour | Auxiliary Building begins to breathe with turnover time of about 4 hours. | About 70% of NG would be released over this period. | 3E-01 | 7E-01 | See above. |
| 4 to 12 hr | Auxiliary Building continues to breathe with turnover time of about 2 hours. | Remainder of noble gases would be released relatively early in this period. | negligible | 1E00 | See above. |

Table A-9
Evaluation of Environmental Releases for Indian Point Sequence V

| Time | Event Sequence | Expected Behavior of Te | Fraction of Core Inventory In Auxiliary Bldg | Fraction of Core Inventory Released to Environment[a] | Explanation of Reasoning |
|---|---|---|---|---|---|
| 0 to few minutes | RHR check valves fail leading to break in 6" line, system depressurizes dumping large amounts of steam and water into Auxiliary Building. | Only the RC FP inventory is involved at this point and most of this will remain in the liquid. | negligible | negligible | No core damage at this point. |
| 10 min to 30 min | Core uncovery begins and core heats up. Release pathway is through upper plenum and hot leg to Auxiliary Building. | Negligible gap release. Initial volatility about equal to Cs (20%) but reduced by at least factor of 10 by reaction with Zr. Another factor of 10 reduction due to plate-out on upper plenum and RHR. Treat Auxiliary Building as breathing inward due to condensing steam. | 2E-03 | negligible | Core release from IPPSS and EPRI/IDCOR studies. Parker (PWR 82) suggests no Te will be released. Major removal by turbulent deposition in RHR. |
| 30 to 60 min | Core melting occurs, release pathways as above. | Additional 30% Te released behaving as above. Auxiliary Building contines to breathe inward. | 5E-03 | negligible | See above. |
| 60 to 70 min | Molten core falling into bottom head of RPV--vessel attack occurring. Release pathway as above. | Release during this brief period included with previous and next entries. | 5E-03 | negligible | |
| 70 to 90 min | RPV bottom head collapses, corium drops onto dry concrete floor and core/concrete interaction begins. Releases are to intact containment. Pathway to Auxiliary Building exists through RPV and RHR. | Allow for remainder of Te to come out of core during concrete reaction (lasting about 10 hours) so about 5%/hr is released. Again reduce by factor of 10 due to gettering. Much of flow will by-pass plenum but not RHR. Use DF = 5. | 5E-03 | negligible | Dominant removal process in Auxiliary Building gravitational settling. |
| 90 min to 4 hour | Auxiliary Building begins to breathe with turnover time of about 4 hours. | Equilibrium is established in Auxiliary Building between input from the source on the containment floor and removals by settling in RPV, RHR and Auxiliary Building. | 5E-03 | 5E-04 | See above. |
| 4 to 12 hr | Auxiliary Building continues to breathe with turnover time of about 2 hours. | See above. | 1E-02 | 1E-03 | See above. |

Table A-10
Evaluation of Environmental Releases for Indian Point Sequence V

| Time | Event Sequence | Expected Behavior of Ba-Sr | Fraction of Core Inventory | | Explanation of Reasoning |
|---|---|---|---|---|---|
| | | | In Auxiliary Bldg | Released to Environment[a] | |
| 0 to few minutes | RHR check valves fail leading to break in 6" line, system depressurizes dumping large amounts of steam and water into Auxiliary Building. | Only the RC FP inventory is involved at this point and most of this will remain in the liquid. | negligible | negligible | No core damage at this point. |
| 10 min to 30 min | Core uncovery begins and core heats up. Release pathway is through upper plenum and hot leg to Auxiliary Building. | Negligible release from core this early in this event. | negligible | negligible | Core release from IPPSS and EPRI/IDCOR studies. |
| 30 to 60 min | Core melting occurs, release pathways as above. | Expect about 2.5% release during this period with DF of at least 10 by plateout on upper plenum and RHR line. Treat Auxiliary Building as breathing in due to condensing steam. | 2E-03 | negligible | See above. Major removal by turbulent deposition in RHR and sedimentation. |
| 60 to 70 min | Molten core falling into bottom head of RPV--vessel attack occurring. Release pathway as above. | Another 2.5% released as above. | 5E-03 | negligible | See above. |
| 70 to 90 min | RPV bottom head collapses, corium drops onto dry concrete floor and core/concrete interaction begins. Releases are to intact containment. Pathway to Auxiliary Building exists through RPV and RHR. | Allow for another 5% of Ba-Sr to come out of core over the next ten hours -- about 0.5%/hr. Much of flow will by-pass plenum but not RHR. Use DF-5. | 5E-03 | negligible | Dominant removal process in Auxiliary Building gravitational settling. |
| 90 min to 4 hour | Auxiliary Building begins to breathe with turnover time of about 4 hours. | Equilibrium is established in Auxiliary Building between input from the source on the containment floor and removals by settling in RPV, RHR and Auxiliary Building. | 5E-03 | 5E-04 | See above. |
| 4 to 12 hr | Auxiliary Building continues to breathe with turnover time of about 2 hours. | See above. | 1E-02 | 1E-03 | See above. |

Table A-11
Evaluation of Environmental Releases for Indian Point Sequence V

| Time | Event Sequence | Expected Behavior of Ru | Fraction of Core Inventory | | Explanation of Reasoning |
|---|---|---|---|---|---|
| | | | in Auxiliary Bldg | Released to Environment[a] | |
| 0 to few minutes | RHR check valves fail leading to break in 6" line, system depressurizes dumping large amounts of steam and water into Auxiliary Building. | Only the RC F' inventory is involved at this point and most of this will remain in the liquid. | negligible | negligible | No core damage at this point. |
| 10 min to 30 min | Core uncovery begins and core heats up. Release pathway is through upper plenum and hot leg to Auxiliary Building. | Negligible release from core this early in this event. | negligible | negligible | Core releases from IPPSS and EPRI/IDCOR studies. |
| 30 to 60 min | Core melting occurs, release pathways as above. | Expect about 2.5% release during this period with DF of at least 10 by plateout on upper plenum and RHR line. Treat Auxiliary Building as breathing in due to condensing steam. | 2E-03 | negligible | Parker [PAR 82] suggests no release of Ru. Major removal mechanisms are turbulent deposition in RHR and sedimentation in other areas. |
| 60 to 70 min | Molten core falling into bottom head of RPV--vessel attack occurring. Release pathway as above. | Another 2.5% released as above. | 5E-03 | negligible | See above. |
| 70 to 90 min | RPV bottom head collapses, corium drops onto dry concrete floor and core/concrete interaction begins. Releases are to intact containment. Pathway to Auxiliary Building exists through RPV and RHR. | Allow for another 5% of Ru to come out of core over the next ten hours -- about 0.5%/hr. Much of flow will by-pass plenum but not RHR. | 5E-03 | negligible | Dominant removal process in Auxiliary Building gravitational settling. |
| 90 min to 4 hour | Auxiliary Building begins to breathe with turnover time of about 4 hours. | Equilibrium is established in Auxiliary Building between input from the source on the containment floor and removals by settling in RPV, RHR and Auxiliary Building. | 5E-03 | 5E-04 | See above. |
| 4 to 12 hr | Auxiliary Building continues to breathe with turnover time of about 2 hours. | See above. | 1E-02 | 1E-03 | See above. |

Table A-12
Evaluation of Environmental Releases for Indian Point Sequence V

| Time | Event Sequence | Expected Behavior of La | Fraction of Core Inventory In Auxiliary Bldg | Fraction of Core Inventory Released to Environment[a] | Explanation of Reasoning |
|---|---|---|---|---|---|
| 0 to few minutes | RHR check valves fail leading to break in 6" line, system depressurizes dumping large amounts of steam and water into Auxiliary Building. | Only the RC FP inventory is involved at this point and most of this will remain in the liquid. | negligible | negligible | No core damage at this point. |
| 10 min to 30 min | Core uncovery begins and core heats up. Release pathway is through upper plenum and hot leg to Auxiliary Building. | Negligible release from core this early in this event. | negligible | negligible | Core releases from IPPSS and EPRI/IDCOR studies. |
| 30 to 60 min | Core melting occurs, release pathways as above. | Expect about 0.25% release during this period with DF of at least 10 by plateout on upper plenum and RHR line. Treat Auxiliary Building as breathing in due to condensing steam. | 2E-04 | negligible | Major removal mechanisms are turbulent deposition in RHR and sedimentation in other areas. |
| 60 to 70 min | Molten core falling into bottom head of RPV--vessel attack occurring. Release pathway as above. | Another 0.25% released as above. | 5E-04 | negligible | |
| 70 to 90 min | RPV bottom head collapses, corium drops onto dry concrete floor and core/concrete interaction begins. Releases are to intact containment. Pathway to Auxiliary Building exists through RPV and RHR. | Allow for another 0.5% of La to come out of core over the next ten hours -- about 0.05%/hr. Much of flow will by-pass plenum but not RHR. | 5E-04 | negligible | Dominant removal process in Auxiliary Building gravitational settling. |
| 90 min to 4 hour | Auxiliary Building begins to breathe with turnover time of about 4 hours. | Equilibrium is established in Auxiliary Building between input from the source on the containment floor and removals by settling in RPV, RHR and Auxiliary Building. | 5E-04 | 5E-05 | See above. |
| 4 to 12 hr | Auxiliary Building continues to breathe with turnover time of about 2 hours. | See above. | 1E-03 | 1E-04[a] | See above. |

[a] Although this analysis suggests a factor of ten lower release for La than for other particulates (due to the lower release from core) in evaluating upper range releases it was decided to use no release fraction less than 1E-03.