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# NAUA Mod 4

## A Code for Calculating Aerosol Behaviour in LWR Core Melt Accidents Code Description and Users Manual

H. Bunz, M. Koyro, W. Schöck
Laboratorium für Aerosolphysik und Filtertechnik
Projekt Nukleare Sicherheit

Kernforschungszentrum Karlsruhe

Kernforschungszentrum Karlsruhe GmbH
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## A Code for Calculating Aerosol Behaviour in LWR Core Melt Accidents

## Code Description and Users Manual

H. Bunz, M. Koyro, W. Schöck

Kernforschungszentrum Karlsruhe GmbH, Karlsruhe

## Abstract

This report describes the computer program NAUA Mod4. Its purpose is to calculate the behaviour of a polydisperse aerosol system in a closed vessel containing a condensing atmosphere as a function of the time. The main object is to explain the physical background and to describe the structure of the code and the input and output in detail.


NAUA Mod 4

Ein Computerprogramm zur Berechnung des Aerosolverhaltens bei einem LWR-Kernschmelzenunfall
Programmbeschreibung und Benutzeranleitung


## Zusammenfassung

Dieser Bericht beinhaltet eine Beschreibung des Computerprogramms NAUA Mod4, dessen Aufgabe die Berechnung des zeitlichen Verhaltens eines polydispersen Aerosolsystems in einem geschlossenen Behälter unter dem Einfluß von Wasserdampfkondensation ist. Der Schwerpunkt liegt dabei auf der Erläuterung der physikalischen Zusammenhänge und der Struktur des Programms sowie der genauen Beschreibung der Ein- und Ausgabe.

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INTRODUCTION

NAUA-Mod 4 is a computer code for calculating the aerosol behaviour in closed vessels containing a condensing steam atmosphere. The code was designed and developed for applications in the field of fission product transport and depletion during core melt accidents in light water reactors, especially pressurized water reactors.

Although the equations for aerosol behaviour do not depend on the container itself and also not on the environmental boundary conditions, the code works with assumptions which are directly related to a melt down accident. Therefore, the code should not be used for completely different applications without careful consideration of its validity. The authors will be happy to assist in such cases.

NAUA-Mod 4 describes the aerosol behaviour only. The containment thermodynamics the source terms for aerosols and steam, and the leakages are external input functions for this code. This implies of course no feedback mechanism between the aerosol and these functions. This is true for a core melt scenario.

Finally, NAUA-Mod 4 calculates physical processes only. Chemical effects in fission product behaviour, as e.g. iodine chemistry, are not included. They have to be accounted for by proper use of the very versatile input capabilities (separate tracking of different species).

NAUA-Mod 4 replaces the older version NAUA-Mod 3 [1]. The main physical improvement was the substitution of the condensation model by an experimentally verified new one [2]. This having been done, all the model equations in the code are verified by single effect experiments. The authors, therefore, consider the code ready for release to interested users. In order to facilitate the application, some changes in the code structure were made to provide input and process options for a wide variety of conceivable cases to be calculated. The most important input capabilities are:

- Time dependent aerosol source structuring.
  Up to 30 arbitrary time intervals may be specified in which instantaneous or constant rate sources occur.

- Bimodal aerosol source size distribution.
  Only for convenience the size distribution is input as a bimodal lognormal

function. The code itself is not restricted to any type of size distribution, and tables of arbitrary size distributions could be used as input if they were given. Source rates for the two modes can be specified independently in every source time interval as well as the size distribution parameters and particle density.

- Multi-species source composition.
  Every source time interval and every mode may contain independent fraction values for up to 50 'nuclides', which are separately tracked throughout the calculation.

- Multi-compartment option.
  Sequential multi-compartment calculations can be done in one job.

- Restart option.
  The restart option can be used when running new cases. A short run can be made and after inspection of the intermediate results the computation can be continued. Also long running cases can be split into more manageable sections.

Large scale demonstration experiments are planned for the emmediate future to show the validity of the calculated results. This appears to be necessary in spite of the fact that the physical models used in the code have been validated experimentally. The authors, however, are confident that no changes in the modeling will become necessary.

Additional numerical improvements which are on going concern mainly the improvement of the problem time/computing time ratio and the interface to containment codes.

## 1. THE PHYSICAL MODEL

The basic physical model in NAUA-Mod 4 is the same as in mode of the advanced aerosol behaviour models for closed containers [3]. The following assumptions are used in order to keep computing time at an adequate level:

- Particles are homogeneously distributed in a control volume except for the boundary layers at the walls.
- Within one particle size class no difference in particle composition is allowed.

- Particle properties are functions of only one independent variable, the particle size, and of the particle density which may change, due to varying particle composition.
- Process coefficient (shape factors, boundary layers etc.) are assumed to be independent on particle size.

For core melt accidents these assumptions are considered to be valid. Internal mixing of species in one size class is quickly achieved by coagulation. The spatial homogenity in the control volume is accomplished by convection, especially in condensing atmospheres. So, presently no reason is known not to use the physical volumes of the reactor building as control volumes. Within a control volume the code calculates the following processes:

- Removal processes
  - Gravitational settling
  - Diffusional plat out
- Interaction processes
  - Brownian coagulation
  - Gravitational coagulation
  - Steam condensation on particles
- Transport processes
  - Aerosol sources
  - Leakages

These processes were chosen because they are dominant. Thermophoresis e.g. has been eliminated because in an LWR it may only occur in the early phases of the accident, when temperature gradients are big enough. During this phase, however, all other processes are vigorous, too. So thermophoresis is considered to be negligible throughout the whole sequence.

Similar considerations were made for other processes that are not included in the model. Should one of them for any reason become important (e.g. in a new application) it could easily be incorporated into the code. In this sense, the code should be regarded as under continuing development.

### 1.1 REMOVAL PROCESSES

The aerosol removal model in stirred conditions is well known [4]. The change

in differential number concentration d n (r) per time interval dt by deposition on a surface is

$$\frac{d\ N\ (r)}{dt} = -\ N\ (r)\ u\ (r) \cdot \frac{A}{V} \qquad (1)$$

where V is the volume in which the aerosol is contained, and A the process related area onto which the deposition of particles takes place; u (r) is the deposition velocity

$$u\ (r) = F \cdot B\ (r) \qquad (2)$$

which a particle of radius r and mobility B (r) attains under the influence of an acting force F. For a spherical particle the mobility B (r) is given by Stokes' law

$$B\ (r) = \frac{C\ (r)}{6\ \pi\ \eta\ r} \qquad (3)$$

with $\eta$ being the viscosity of the carrier gas and C (r) the empirical Cunningham correction factor.

In NAUA-Mod 4 the equation

$$C\ (r) = 1 + 1.246 \cdot Kn + 0.42 \cdot Kn \cdot \exp\ (-\ \frac{0.87}{Kn}) \qquad (4)$$

is used (Kn = Knudsen number) [5].

In NAUA-Mod 4 the size parameter r is the volume equivalent radius, which for normal applications is equal to the Stokes' radius (c.f. section "shape factors" for detailed information).

For gravitational settling the steady state settling velocity is obtained by substituting the gravitational force for F in eq. (2)

$$u_S\ (r) = \frac{2\rho_{eff} \cdot g}{9\ \eta} \cdot r^2 \cdot C\ (r) \qquad (5)$$

with g, the gravitational constant, and $\rho_{eff}$ the effective density of the (spherical) particle.

For gravitational settling the surface area A in eq (1) has to be taken as the sum of all upward facing horizontal projections of surfaces in the volume V. For all other processes the orientation of the surfaces is irrelevant.

For <u>diffusional deposition</u> the equation

$$u_D\ (r) = \frac{D\ (r)}{\delta} \tag{6}$$

is used. D (r) is the diffusion constant

$$D\ (r) = kT \cdot B\ (r) \tag{7}$$

with k the Boltzmann constant and T the absolute temperature.

$\delta_D$ is the diffusional boundary layer across which the particle concentration drops to zero with a constant gradient. NAUA-Mod 4 uses $\delta_D$ as a constant input parameter, a value of $\delta_D$ = 0.01 cm is appropriate for most cases.

## 1.2 INTERACTION PROCESSES

Interaction processes are most important for the behaviour of highly concentrated aerosols because they are responsible for the non linear behaviour of aerosol removal. They are calculated with very high time and particle size resolution and this calculation consumes most of the computation time. The two interaction mechanisms considered in NAUA-Mod 4 are coagulation and steam condensation.

### Brownian Coagulation

The collision frequency $K_b$ due to Brownian motion is given by

$$K_b\ (r_i, r_k) = 4\ \pi\ KT \cdot (r_i + r_k)\ (B\ (r_i) + B\ (r_k)) \tag{8}$$

$r_i$ and $r_k$ are the radii of the two particles involved in the coagulation process. The result of the process is the disappearing of the two particles and the creation of a new one with a mass and volume equal to the sum of the masses and volumes of the two original particles. Regarding the new particle as spherical too, one obtains the following conservation rules for the individual coagulation process

$$
\begin{aligned}
m_j &= m_i + m_k \\
v_j &= v_i + v_k \\
r_j^3 &= r_i^3 + r_k^3
\end{aligned}
\qquad (9)
$$

where the subscript j denotes the new particles.

Gravitational Coagulation

The collision frequency $K_g$ due to gravitational coagulation is given by

$$K_g\,(r_i,\, r_k) = \pi \cdot \varepsilon \cdot (r_i + r_k)^2 \cdot /u_s\,(r_i) - u_s\,(r_k)/ \qquad (10)$$

The problem in this equation is the value of the collision efficiency $\varepsilon$. NAUA-Mod 4 uses the size dependent expression given by Pruppacher /‾6_7

$$\varepsilon = \frac{1}{2}\,\left(\frac{r_i}{r_i + r_k}\right)^2 \;;\quad r_i < r_k \qquad (11)$$

rather than a constant value, which might not represent the situation correctly over the whole real time period of a calculated case.

The calculation of steam condensation on particles is a very fast molecular process, it may also contribute much to the removal of particles through generation of large fast settling droplets.

The obvious solution, to expand eq (8) and (10) down to molecular size values, cannot be used for reasons of computing time. Therefore, a more simple but yet precise enough description of the process had to be found. An iterative process of analytical studies and experimental investigations lead to the following model.
The change in radius of a particle due to condensation or evaporation of steam can be described by

$$r\,\frac{dr}{dt} = \frac{S - \exp\,\{2\sigma M \rho_w R T_r \quad 1/r\}}{\dfrac{L\rho_w}{KT_\infty}\,\left(\dfrac{LM}{RT_\infty} - 1\right) + \dfrac{\rho_w\,RT_\infty}{MDP_s}} \qquad (12)$$

with

S steam saturation ratio
$\sigma(Tr)$ surface tension of water

| | |
|---|---|
| M | molar weight of water |
| $\rho_w(Tr)$ | specific density of water |
| R | universal gas constant |
| $T_r$ | temperature of the droplet |
| $T_\infty$ | temperature of the carrier gas |
| L(Tr) | latent heat of water |
| $K(T_\infty)$ | heat conductivity of water vapor |
| $P_s(T_\infty)$ | saturation pressure of water vapor |

It is assumed that the ieeal gas law holds and that $T_r \approx T_\infty$.
$\sigma$, $\rho_w$, L, K and $P_s$ are calculated as functions of temperature every time step.

This equation was derived for thermal equilibrium conditions in normal atmospheres. It was dthe objective of an experimental project to measure the possible deviations from eq (12) in a simulated accident atmosphere with realistic pressure, temperatures and aerosols, the result of the experiments was that the equation can be used without any corrections [2]. Obviously the steam concentration and the related changes at elevated temperatures are so high that no time delays or second order effects become noticeable. On the other hand, because the concentration changes and consequently the particle size changes are fast and big, a separate, much finer time integration scheme has to be used for evaluating eq (12). If the condensation process was calculated too coarsely (e.g. by using the time steps with which the other aerosol processes are calculated), overshooting and instable oscillations about the saturation limit could occur.

Consequently, the condensations routines consume much computation time and the code contains control parameters to suppress them whenever not needed.

### 1.3 TRANSPORT PROCESSES

Since the NAUA code is designed for closed containers, the only transport effects considered are aerosol sources and leakages. They are accounted for as volume sources and sinks, which means that no depletion in transport paths is calculated within the NAUA code.

The aerosol source has to be specified as input data. Arbitrary time functions, size distribution parameters, particle densities and nuclide composition are acceptable.

The leakage is specified as input data, too. No size dependent effects are taken into account by the code.

### 1.4 SHAPE FACTOR CONSIDERATION

The most important by-product of the experimental investigations was the confirmation of the spherification process. Particles undergoing condensation - evaporation processes are compressed to almost spherical shape. The residual deviation from ideal spheres is small and does not need to be taken into account in the model. The process also compacts coagulated aggregates of previously compacted particles. The effect was experimentally established with non-hygroscopic particles, it will certainly be stronger for soluble and hygroscopic particles.

It is unconceivable then, that the spherification effect should not occur in a water reactor accident for more than very short time periods or very small spaces in the building. Therefore, the spherical shape can be assumed throughout the calculation. Consequently all shape dependent shape factors could have been eliminated from the code equations. This has not been done in order to keep the code applicable for future problems of different nature, but the corresponding shape factors are input parameters whose value should be set equal to unity. These are the following three shape factors, which were not written in the above equations:

- the dynamic shape factor $\kappa$ to be inserted in the denominator of eq (3)
- the coagulation shape factor f multiplied into eq (8)
- the condensation shape factor $f_m$, which is a factor in the exponential in eq (12).

Defining these shape factors as only shape dependent requires the use of a density correction for porous particles in eq (5) for gravitational settling and in eq (10) for gravitational coagulation. This is most conveniently done by using an effective density $\rho_{eff}$ instead of the material density $\rho$ Effective densities have to be determined experimentally, for $UO_2$ aerosols

$$\rho_{eff}/\rho = 0.47$$

was measured in [2] for the spherified particles. Therefore, unless special values are given, a density reduction by 50% can be recommended for all

insoluble particle materials. The effective density is the density input parameter for the NAUA code.

### 1.5 COMBINATION OF PROCESSES

In NAUA-Mod 4 the different aerosol processes are treated as additive. Occasionally the question was raised whether this assumption may be too rough or not [7]. The second order correction in the combination of any two simultaneous processes, however, depends on the rate of both of them. And the error in computed results increases with the length of the time step. The code, therefore, automatically adjusts the time step duration such that the fastest aerosol process mostly (brownian coagulation) does not lead to too large changes in any particle size class. This algorithm is controlled by an accuracy parameter, the value of which was determined in parameter studies. The accuracy parameter is included in the input list and has to be used with care.

For the computation of condensation a separate similar procedure is used, which controls the condensation time step. It is smaller than or equal to the coagulation time step. These precautions keep errors within limits which are acceptable for the normal application of the code to core melt accident analyses.

## 2. THE NUMERICAL MODEL

### 2.1 THE MODEL EQUATION

If all the mathematical expressions for the different physical processes discussed in the previous chapters are combined, the complete model equation is obtained.

$$\frac{\partial n\,(r,\,t)}{\partial t} = S\,(r,\,t) - (\ _D(r) + \ _s(r) + \ _T(r))\ \ n\,(r,\,t)$$

$$+ \int_0^{r/\sqrt[3]{2}} K\,(\sqrt[3]{r^3 - r'^3},\, r')\, n\,(\sqrt[3]{r^3 - r'^3},\, t)\, n\,(r',\,t)\ \frac{r^2}{(r^3 - r'^3)^{\frac{2}{3}}}\ dr'$$

$$- n(r,\,t) \int_0^{\infty} K\,(r,\,r')\, n\,(r',\,t)\, dr' + \frac{\partial r}{\partial t} \cdot \frac{\partial n\,(r,t)}{\partial r} \qquad (13)$$

This integro-differential equation can be solved only numerically. To facilitate this solution the particle size distribution expressed by n (r) is approximated

by a number of monodisperse fractions (a kind of histogram). By this manipulation the given integro-differential equation can be transformed into a system of coupled first order differential equations.

$$\frac{\partial n(k_k,t)}{\partial t} = S(r_k, t) - (\alpha_D(r_k) + \alpha_S(r_k) + \alpha_T(r_k) + \alpha_L(r_k)) \cdot n(r_k, t)$$

$$- \sum_{i=1}^{N} (1 - 1/2\, \delta_{ik}) \cdot K(r_i, r_k) \cdot n(r_i, t) \cdot n(r_k, t)$$

$$+ 1/2 \sum_{i=1}^{N} \sum_{j=1}^{N} K(r_i, r_j)\, \beta_{ij}^{k} \cdot n(r_i, t) \cdot n(r_j, t)$$

$$+ (1 - \delta_{1k}) \frac{\dot{V}_{k-1}(t)}{V_k - V_{k-1}} \cdot n(r_{k-1}, t) - \frac{\dot{V}_k(t)}{V_{k+1} - V_k} \cdot n(r_k, t)$$

for $k = 1, \ldots, N$

Such an equation system can be treated much more easily and numerically more stable than the complete integro-differential equation as it was found by experience [9]. One difficulty arising by this reformulation is that the new particles formed by coagulation do not fit into the given classification of the particles if a non-mass equidistant classification is applied as usual. Therefore, an interpolation has to be performed whereby the new-formed particles are distributed between the two particle size classes nearest to the new particles. This interpolation conserves the particle number and mass.

Another problem is the composition of the particles of the two components, a non-volatile solid fraction and a volatile liquid fraction. On the one hand it is not possible to assume homogeneous mixing over the whole particle size distribution because the condensation and evaporation rates (eq 12) are strongly dependent on the particle size, on the other hand the introduction of a second dimension describing the different composition of the particles in addition to their size is too time-consuming and therefore not practicable. The composition of the particles is, therefore, averaged in each size class but varies from size class to size class. The variation of the composition is calculated taking into account the influence of the coagulation of differently composed particles, sources of new particles and the condensation of water on the particles. Fortunately, it can be shown [2] that the sedimentation of the solid fraction (carrying the radioactivity) is underestimated by this simplification and therefore justified.

## 2.2 THE SOLUTION TECHNIQUE

The equation system (14) is solved by the Euler-Cauchy-method which is a standard numerical technique. To ensure the numerical stability, the time step is calculated by the code itself using the ratio of the first to the zeroth derivative as a measure because, fortunately, it can be shown that this ratio is of the same order as the ratio of the second to the first derivative justifying this procedure.

This method is used for the main part of the equation controlling the coagulation and the depletion processes. The condensation, however, as the fastest and to numerical instabilities most sensitive process is integrated in a separate routine where the time step is calculated by the difference between the result after the full time step and two half time steps. If the stability criterion is violated, the code goes back to the beginning of the time step and starts again with a smaller time step. The principle scheme of the code can be seen best in the block diagram (fig. 1).

## 2.3 PROGRAM UNITS

1. MAIN

The most input data are read here and all the necessary starting values are set. To save computation time the temperature independent parts of the depletion coefficients are calculated before the entry into the time loop. In the time loop the coagulation is computed except the coagulation frequencies. Taking into account the result of the coagulation and the removal processes the new particle size distribution is calculated after the time step DELZEI which is calculated in the subroutine DELTIM. All removal coefficients are temperature dependent. Some of the necessary values like the viscosity and the mean free path are provided as statement functions.

At the same time the mass depleted by the different processes is calculated. Using the new distribution,the dry, liquid as well as the total airborne mass, the number concentration and the average radius are computed. Dependent on the number of time steps, a small or a large output including the particle size distribution are printed. To limit the amount of output the printing frequency is also restricted to a certain part of the total problem time.

Therefore, the time between each printing is at least 1/1000 of the problem time. Also data are written on predefined files to prepare plots of mass and number concentration, average radius and other values versus time, and of size distributions at different times.

At the end of the time loop the code enters the concensation subroutine NEWCON and goes back to the beginning of the loop if the stop condition is not fulfilled.
If the stop condition is valid, all data necessary for restarting the code are written on the restart file and the execution is terminated.

2. CUN (subroutine)

The size and temperature (because of the temperature dependent mean free path) dependent slip-flow mobility correction (Cunningham correction) is calculated according to the values given by Millikan and Fuchs.

3. KERN (subroutine)

The coagulation frequencies, brownian as well as gravitational, are calculated here. To save computation time in cases when only brownian coagulation is requested, two different entries for these two different requests are provided. As already mentioned, the Fuchs formulation is used for the collision efficiency.

4. DELTIM (subroutine)

The time step DELZEI is calculated due to the criterion explained in the previous chapter. The size of the time step and by this the integration accuracy can be influcenced by the parameter EPS.

5. SOURCE (subroutine)

The size dependent source of solid particles is computed from the given input data assuming for convenience a bomodal lognormal distribution because for nearly all applications only some average particle sizes are known and, therefore, exact size distributions are not available. But in principle also an arbitrary table can be read as size distribution. This option is used in the next subprogram READL. The release of the particles can be given as a long time source or as a puff release.

Also the time dependent particle density and the time dependent contents of

the different nuclides are calculated here, assuming that all material released is instantaneously mixed over the whole solid part of the particle size distribution at the moment of its release.

6. READL (subroutine)

This subprogram provides the particle sources for secondary compartment runs. It reads the size and time dependent leakage of a proceeding run. Therefore, no further assumptions concerning the size distribution of the source particles for the secondary compartment have to be made.
As in the subprogram SOURCE, the time dependent particle density, and the nuclide contents are calculated.

7. NEWCON (subroutine)

This subprogram performs the numerical integration of the growth rate due to steam condensation according to the Mason equation. All important parameters are given as temperature functions, mostly in the form of statement functions. At the end of the subroutine the particles are interpolated into the predefined size classification according to their changed sizes.

8. DRYOUT (subroutine)

The liquid part of the particles, which leave the compartment through a leak, is removed and the particles are interpolated into the predefined size classification according to the sizes of their solid part. The obtained size dependent leak rates can be read again by the subroutine READL in a subsequent job. The particles are reduced to their solid part since normally the thermodynamic conditions are different in the various compartments causing diffuculties predicting the behaviour of the volatile part. To be on the safe side it is therefore assumed that the particles become dry if they are transferred from one compartment to another.

9. TEMPCI (function)

The containment temperature is read as a time equidistant table. The actual temperature is calculated by linear interpolation between the given grid points. If the time is greater than the time of the last grid point, the temperature is assumed to be constant at this temperature for the rest of the calculation. The normal entry into the function (except the first one) is called TEMPC.

10. DRWURZ (function)

The third root of any number is calculated there.

11. STEAMI (function)

The steam source is read as unarbitrary table containing the time and the steam flow rate at a number of grid points. Between the grid points the steam flow rate is assumed to be constant. If the last steam flow rate is not equal to zero, the code produces an additional grid point at the end of the problem time with a flow rate equal to zero. The normal entry into the function (except the first one) is called STEAM.

12. TLEAKI (function)

The leak rate of the compartment is read as an arbitrary table containing the time and the leak rate at a number of grid points. The structure of the data is the same as that of the steam flow.
Between the grid points the code assumes linear interpolation. If the last leak rate is not equal to zero, the code produces an additional grid point at the end of the problem time with the leak rate equal to zero exept that only one grid point is given. In this case the leak rate is assumed to be constant at this value for the whole calculation. The normal entry into the function (except the first one) is called TLEAK.

## 2.4 INPUT

The complete input list is shown in fig. 2. It can be seen that the whole "normal" input is read list-directed from a data set corresponding to the data set reference number 5 except the two text lines for the head line. They are read by a format 18A4 (format statement 6031). All input data written by preceding runs of the code are provided as unformatted data. These are:

1. Restart data set (from uni 10)

This data set enables the user to start the calculation again if the execution was terminated by reaching the problem time or the given CPU-time. The input from the unit 5 has to be the same as for the first run except the parameter RESTRT. It has to be set on •TRUE• insted of FALSE . If RESTRT is equal to •TRUE•, the code expects a restart data set.

2. Leakage (from unit 2)

If a run is performed for a subsequent compartment, the code expects the leakage written on a file by the preceding run as input. It contains the size of the preceding volume, the number and names of nuclides, contents of the various nuclides, the density of the particles and the size dependent leakage at all time steps of the preceding run.

3. CPU-time (from unit 19)

If runs of several compartments are performed in one job but different steps (see examples 3 to 5), the CPU-time needed for the stop condition has to be transferred from step to step because the code has to know the whole CPU-time consumed already by the previous steps. Therefore, only the CPU-time (CPUZT) read in the first step is important and should be equal to the time given on the job card. In the subsequent steps it is read over by the value from unit 19.

A list of the variables read by the card reader (unit 5) including the explanations of their meaning is viven in table 1.

## 2.5 OUTPUT

The printed output (unit 6) comprises the input data, some informational output concerning the start of condensation and the preceding run for secondary compartment runs, a small output containing the values of the actual mass and number concentration, the depletet masses and so on and a large output consisting of the same data as the small one plus the particle size distribution. The printed output is selfexplanatory as it can be seen in the examples given in the appendix. Therefore, no further explanation is necessary.

In addition to the printed output some other output options are provided. Since all these data are read during other runs of the NAUA code itself or by other codes like plot programs, they are all written unformatted.

1. Restart data set (unit 9)

If the execution is terminated by reaching the problem time or by using up the given CPU-time, a restart data set is written to enable the user to continue the run by a new job. The consumed CPU-time has to be calculated by the code using a machine-dependent routine.

For further details see also the explanation of the parameter RESTRT in table 1.

2. Leakage (unit 1)

At each time step the code writes the size dependent leakage on a data set (variable ZLEAK), the actual contents of the various nuclides and the actual density of the particles onto this data set. At the beginning of the run (except for restarted runs) the size of the volume, the number of nuclides, the names of the nuclides and the duration of the particle source is written onto this data set. The data set is therefore very large in most cases, e.g. in the order of 10 MBytes.

3. CPU-time (unit 19)

For details see the description of the CPU-time data set in the previous chapter (description of the input). The data set is rewinded at the end of the run and the remaining CPU-time is written on it. It may be defined as a very small temporary data set.

4. Plot dat set (uni 8)

To enable the user to produce plots of the various time dependent values, the necessary data are written onto this data set. It can be read again by any suitable plot program. The variables contained in each record of the data set are listet in table 2.

5. Plot data set for the particle size distribution (unit 3)

Each time, the large output is printed, the particle size (number) distribution is written onot this data set to enable the user to plot the size distribution at this time. The variables written on each record are listed in table 3.

If a problem is computed by a number of restarted jobs, the data sets 2, 4, 5 can be simply concentrated in the proper order, of course, since the starting records are written only in the first job and the structure of all other records is the same.

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PARDISEKO IIIb - Ein Computerprogramm zur Beschreibung des Aerosolverhaltens in geschlossenen Behältern
KfK 2903 (April 1980)

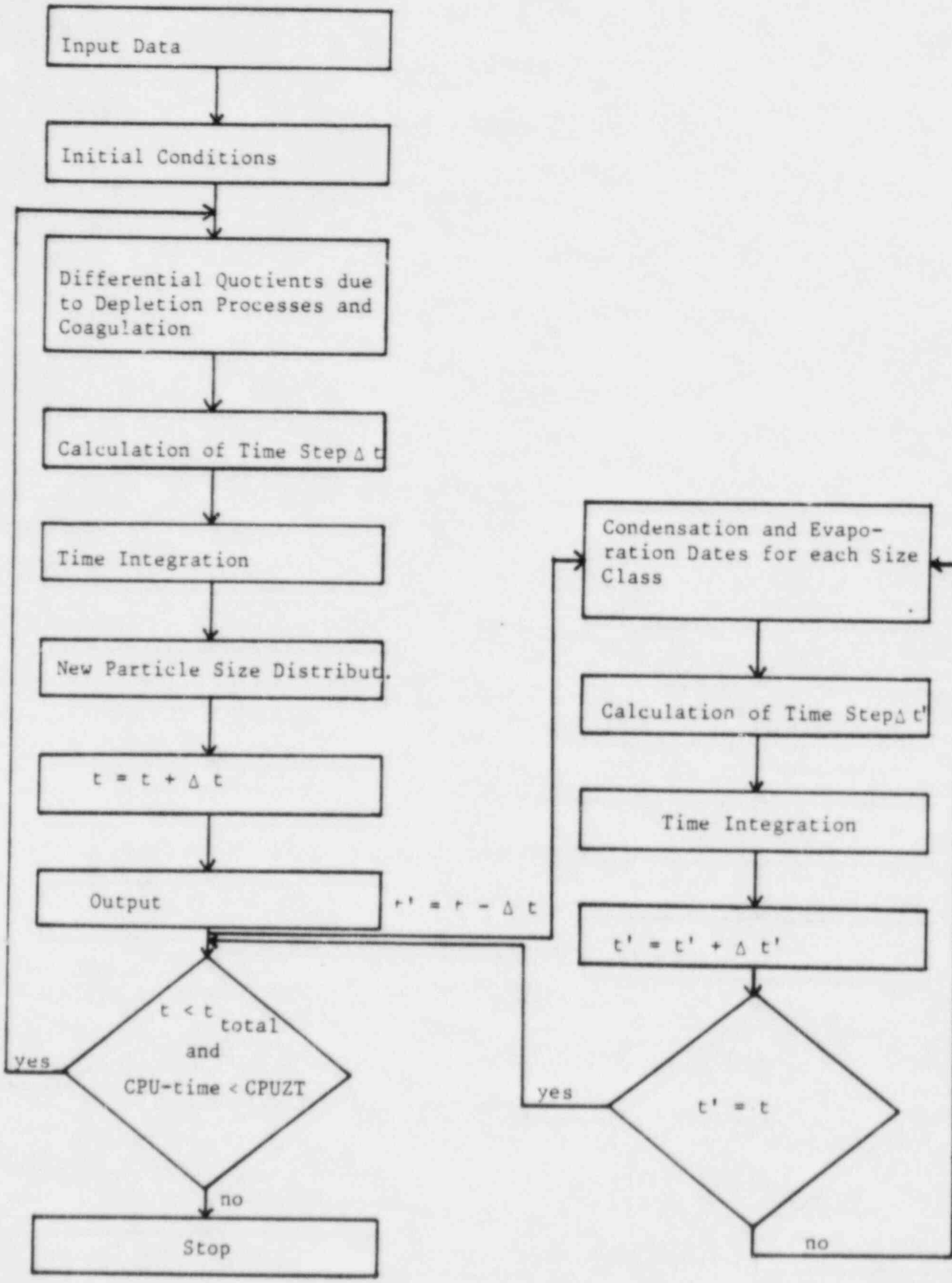



Fig. 1 Block Diagram of the NAUA-Code

```
C     MAIN PROGRAM
      READ (5,6031) TEXT
 6031 FORMAT (18A4)
C
C     INPUT BY LIST-DIRECTED INPUT
C     VARIABLE NDUMMY TO READ THE LINE NUMBER IF NUMBERED RECORDS ARE
C     USED AS INPUT
C     IF NON-LINE-NUMBERED RECORDS ARE USED, NDUMMY HAS TO BE REMOVED
C
      READ (5,*) VOL,FSED,FDIFF,NDUMMY,
     +           FORM,FORMC,FORMKO,DELD,NDUMMY,
     +           RMIN,RMAX,KMAX,EPS,CUTOFF,NDUMMY,
     +           SZEIT,TIME,CPUZT,NDUMMY,
     +           RESTRT,ZWCOMP,FOLGE,GRAVK,LEAK,NDUMMY,
     +           LKOND,TIMEK1,TIMEK2,TIMEK3,TIMEK4,NDUMMY,
     +           NWRITE,NPLOT,NDUMMY,
     +           NPHASE,NUKLID,NDUMMY,
     +           (SRATE(1,I),KONTIN(1,I),RG(1,I),
     +           SIGL(1,I),RHO1(1,I),NDUMMY,
     +           SRATE(2,I),KONTIN(2,I),RG(2,I),
     +           SIGL(2,I),RHO1(2,I),TQ(I+1),NDUMMY,
     +           (NAMNUC(K),AKTIVI(1,I,K),AKTIVI(2,I,K),NDUMMY,
     +           K=1,NUKLID),I=1,NPHASE)
C
      READ (19,END=50) CPUZT
C
      IF (ZWCOMP) READ (2) VOL1,NUKLID,SOUTIM,(NAMNUC(K),K=1,NUKLID)
C
   90 READ (10) SZEIT,ZCON,TCE,DELZEI,DEPDIF,DEPSED,DEPD2,DEPD3,DEPS2,
     +          DEPS3,NTOT,SUMLK,SUMLKA,AKTIV,W11,V,Z,RHOB,KULIM,KOLIM,
     +          S,AVMAS1,AVMAS2,ZNORM,FIRST,DELTAT,DAMPFM,SGEWTR,DEPDA,
     +          DEPSA,SUMSOU,NUKLID,NAMNUC
C
  120 IF (ZWCOMP)
     +    CALL READL (Z,V,SZEIT,DELZEI,CUTOFF,RHOB,AKTIV,NUKLID,SGEWTR,
     +                KULIM,KOLIM,DILUTE,ZWCOMP)
C
      SUBROUTINE READL (Z,V,ZEIT,DELTAT,CUTOFF,RHOB,AKTIV,NUKLID,SGEW,
     +                  KULIM,KOLIM,DILUTE,ZWCOMP)
C
      READ (2,END=90) ZEIT2,RHO2,RLPV2,(AKTIV2(K),K=1,NUKLID),
     +                (Q2(K),K=1,KMAX)
C
      FUNCTION TEMPCI (T)
      READ (5,*) N,DELT
      READ (5,*) ((TI(9*(I-1)+K),K=1,9),NDUMMY,I=1,NN)
C
      FUNCTION STEAMI (T1)
      READ (5,*) N,NDUMMY,(TD(K),D(K),NDUMMY,K=1,N)
C
      FUNCTION TLEAKI (T)
      READ (5,*) N,NDUMMY,(TL(K),RL(K),NDUMMY,K=1,N)
```

FIG. 2   INPUT LIST

Table 1: Card-Input (Remark: R4 : Real 4 R8: Real 8 I: Integer 4
L: Logical 4)

| Card Number | Variable | Type | Explanation | Dimension | Recommended Value |
|---|---|---|---|---|---|
| 1 + 2 | TEXT (1..,36) | R4 | Head-line to be printed to identify the job | - | - |
| 3 | VOL | R4 | Volume of the compartment | $cm^3$ | - |
| | FSED | R4 | Floor area of the compartment | $cm^2$ | - |
| | FDIFF | R4 | Total surface area of the compartment | $cm^2$ | - |
| 4 | FORM | R4 | Mobility shape factor } for the experimental values see /1/ | - | 1. |
| | FORMC | R4 | Coagulation shape factor } for the experimental values see /1/ | - | 1. |
| | FORMKO | R4 | Condensation shape factor } for the experimental values see /1/ | - | 1. |
| | DELD | R4 | Diffusional boundary layer | cm | 0.01 |
| 5 | RMIN | R4 | Lower size limit of the particle classification | cm | < 1.E-6 |
| | RMAX | R4 | Upper size limit of the particle classification | cm | 20.E-4 - 100.E - 4 |
| | KMAX | I | Number of classes of the particle classification | - | 80 - 110 |
| | EPS | R4 | Accuracy parameter for time integration | - | 0.1 |
| | CUTOFF | R4 | Cutoff value for particle size distribution. If the number of particles in a class is smaller than CUTOFF, the class is set to zero | $cm^{-3}$ | 1.E - 15 |
| 6 | SZEIT | R4 | Starting time of the problem, equals the time of first particle release in the accident to be analysed | sec | - |
| | TIME | R4 | Total problem time. After reaching this time the execution is terminated | h | - |

(Table 1 cont')

| | | | | | |
|---|---|---|---|---|---|
| | CPUZT | R4 | Same CPU-time as inserted on the job card. If the CPU-time is reached, the execution is terminated and restart data are written onto the restart file. To do this a machine dependent routine has to be used to calculate the CPU-time already consumed | min | - |
| 7 | RESTRT | L | Flag to expect a restart file .FALSE. (= NO) | - | - |
| | ZWCOMP | L | Flag to indicate a subsequent compartment run, data written by a preceding job are expected .FALSE. (= NO) | - | - |
| | FOLGE | L | Flag to indicate that a run will be made reading the leakage of the actual run as input. Activates the subroutine DRYOUT .FALSE. (= NO) | - | - |
| | GRAVK | L | Activates the gravitational agglomeration .FALSE. (=NO) | - | - |
| | LEAK | L | Activates the leakage .False. (= NO) | - | - |
| 8 | LKOND | L | Activates the steam condensation onto the particles .FALSE. (= NO) | - | - |
| | TIMEK1 | R4 | Lower and upper time limit of the first period of condensation | sec | - |
| | TIMEK2 | R4 | | sec | - |
| | TIMEK3 | R4 | Lower and upper time limit of the second period of condensation | sec | - |
| | TIMEK4 | R4 | | sec | - |

(Table 1 cont')

| | | | | | |
|---|---|---|---|---|---|
| 9 | NWRITE<br>(1,2) | I | (1): Number of time steps a small output has to be printed | - | - |
| | | | (2): Number of time steps a large output has to be printed including the size distribution | - | - |
| | NPLOT | I | Number of time steps data have to be written onto the plot data set | - | - |
| 10 | NPHASE | I | Number of release periods for the particle source | - | ≤ 30 |
| | NUKLID | I | Number of nuclides to be balanced | - | ≤ 50 |
| (2 + NU-<br>KLID)*<br>(I-1)<br>+ 11 | SRATE<br>(1,I) | R4 | Source rate for particle release for the mode 1 in period I | g or<br>g/sec | - |
| | KONTIN<br>(1,I) | L | Flag to indicate if SRATE (1,I) is a puff or a continuous release<br>.TRUE.: continuous<br>.FALSE.: puff | - | - |
| | RG(1,I) | R4 | mean geometric radius of mode 1 in period I | cm | - |
| | SIGL(1,I) | R4 | logarithmic variance of mode 1 in period I | - | - |
| | RHO1(1,I) | R4 | particle density of mode 1 in period I | g/cm³ | - |
| (2 + NU-<br>KLID)*<br>(I-1)<br>+ 12 | SRATE(2,I) | R4 | the same meaning as the above values but for the mode 2 in period I | g or<br>g/sec | - |
| | KONTIN<br>(2,I) | L | | - | - |
| | RG(2,I) | R4 | | cm | - |
| | SIGL(2,I) | R4 | | - | - |
| | RHO1(2,I) | R4 | | g/cm³ | - |
| | TQ (I+1) | R4 | end of release period I | sec | |
| (2 + NU-<br>KLID)*<br>(I-1)<br>+12+K | NAMNUC(K) | R8 | Name of nuclide K | - | - |
| | AKTIVI<br>(1,I,K) | R4 | Content of nuclide K in mode 1 of period 1 as mass fraction | - | - |
| | AKTIVI<br>(2,I,K) | R4 | The same for mode 2 | - | - |

(Tabl. 1 con')

These (NUKLID + 2) * NPHASE (= NMAIN-10) cards define the complete particle source including the information about the contents of the various nuclides. The names of the nuclides may not be different in the different release periods.

| | | | | | |
|---|---|---|---|---|---|
| | | | - in function TEMPCI - | | |
| NMAIN + 1 | N | I | Number of grid points for the temperature function | - | ≤ 200 |
| | DELT | R4 | Time interval for the time-equidistant temperature table | | |
| NMAIN +K+1 up to NMAIN +N+1 = NT | TI (K) K = 1,N | R4 | Table of the containment temperature | C | - |
| | | | - in function STEAMI - | | |
| NT + 1 | N | I | Number of grid points of the steam source | - | ≤ 200 |
| NT+K+1 | TD(K) | R4 | Time at the grid point K of the steam source | sec | - |
| | D(K) | R4 | Steam flow rate from time TD(K) to TD (K+1) | g/sec | - |
| up to NT+N+1 = NST | | | | | |
| | | | - in function TLEAKI - | | |
| NST+1 | N | | Number of grid points of the containment leakage | - | ≤ 200 |
| NST+K +1 | TL(K) | | Time at the grid point K of the leak rate | sec | - |
| | RL(K) K = 1,N | | Leak rate out of the compartment at the grid point K | $sec^{-1}$ | - |
| up to NST +N+1 | | | | | |

Table 2: Structure of Plot Data

Remark: All Variables are of type Real 4

| Variable | Explanation | Dimension |
|---|---|---|
| SZEIT | time | sec |
| CON | particle number concentration | $cm^{-3}$ |
| SGEW | total mass concentration | $g/cm^3$ |
| RAV | average radius | cm |
| DEPDIF | accumulated deposition due to diffusion | $g/cm^2$ |
| DEPSED | accumulated deposition due to sedimentation | $g/cm^2$ |
| SGEWTR | solid part of SGEW | $g/cm^3$ |
| SGEWWS | liquid - " - | $g/cm^3$ |
| DEPD2 | solid part of DEPDIF | $g/cm^2$ |
| DEPD3 | liquid - " - | $g/cm^2$ |
| DEPS2 | solid part of DEPSED | $g/cm^2$ |
| DEPS3 | liquid - " - | $g/cm^2$ |
| SUMLK | accumulated leakage out of the compartment | g |
| AIRM | total airborne mass | g |
| AIRMT | solid part of AIRM | g |
| AIRMW | liquid - " - | g |
| NUKLID | number of nuclides | g |

Table 3: Structure of Data to plot the size distribution

| Variable | Type | | Dimension |
|---|---|---|---|
| NTOT | I * 4 | number of the actual time step | - |
| SZEIT | R * 4 | time | sec |
| Z (K)<br>K = 1,<br>KMAX | R * 4 | particle number in class K | $cm^{-3}$ |

Table 4: Structure of the first record of the data set to plot the size distribution

| Variable | Type | Explanation | Dimension |
|---|---|---|---|
| KMAX | I * 4 | total number of size classes<br>(see input list) | - |
| R (K)<br>K = 1,<br>KMAX | R * 4 | radius of the particles in the<br>size class K | cm |
| X (K)<br>K =1,<br>KMAX | R * 4 | logarithm of the radius | - |

Appendix

Sample Problems

Case 1:

Single compartment calculation with an instantaneous aerosol source and without steam condensation. Simple and fast running sample for first check after installation of the code.

Case 2:

Two compartment calculation taking into account a best estimate aerosol source for a core melt down accident in a 1300 MW PWR and steam condensation on the particles in the containment. The droplets are assumed to evaporate after leaking into the annular gap as the secondary compartment.

Technical remarks:

Both examples consist of the following data:

- Complete set of job control cards for an IBM machine including the card input (Unit 5).
- Input values as printed out by the code at the beginning of each run.
- Examples of calculated values as printed out at certain time steps.
- Plots of the total airborne mass, the total accumulated leaked mass of certain nuclides and the particle size distribution at different times.

For the second sample problem the last three items are given for each compartment corresponding to the two steps in this job.

```
//LAF295E1  JOB (0295,691,P4311),KOYRO,NOTIFY=LAF295,TIME=120
//*MAIN LINES=30
//E1  EXEC F7CG
//C.SYSPRINT DD DUMMY
//C.SYSIN     DD  DISP=SHR,DSN=TSO657.NAUAMOD4.FORT
//G.FT01F001  DD  DUMMY
//G.FT02F001  DD  DUMMY
//G.FT03F001  DD  UNIT=DISK,VOL=SER=BAT00H,DISP=(,CATLG),
//    DSN=LAF295.E13.DATA,SPACE=(TRK,(20,5)),DCB=DCB.VBS
//G.FT08F001  DD  UNIT=DISK,VOL=SER=BAT00H,DISP=(,CATLG),
//    DSN=LAF295.E18.DATA,SPACE=(TRK,(20,5)),DCB=DCB.VBS
//G.FT09F001  DD  DUMMY
//G.FT10F001  DD  DUMMY
//G.FT19F001  DD  DUMMY
//G.SYSIN     DD  *
 NAUA SAMPLE CASE # 1------------------------------------------------
 POINT SOURCE, NO STEAM, GRAVK, SINGLE COMP. ----------------------
72000.E6  6460.E4  50540.E4
1.  1.  1.  0.01
0.0025E-4  20.E-4  101  0.1  1.E-15
0.0  100.  20.
.F.  .F.  .F.  .T.  .T.
.F.  5.E5  6.E5
10  100  5
2   3
1000000.  .F.  0.4E-4  0.7  4.
      0.  .F.  0.4E-4  0.7  4.  5000.
'NUCL 1'  0.02  0.
'NUCL 2'  0.04  0.
'NUCL 3'  0.    0.
 500000.  .F.  0.5E-4  0.8  3.
 400000.  .F.  0.6E-4  0.4  2.  6000.
'NUCL 1'  0.    0.
'NUCL 2'  0.05  0.08
'NUCL 3'  0.03  0.04
1  1.
130./
1
0.  0.
1
0.  1.16E-7
//
```

NAUA - MOD4 INPUT DATA LISTING
**********************************************

TEXT : NAUA SAMPLE CASE # 1 ----------------------------------------------------
POINT SOURCE, NO STEAM, GRAVK, SINGLE COMP. ----------------------

| | | | |
|---|---|---|---|
| CONTROL VOLUME PARAMETERS | VOL | : | 0.72000E+11 |
| | FSED | : | 0.64600E+08 |
| | FDIFF | : | 0.50540E+09 |
| AEROSOL PROCESS PARAMETERS | FORM | : | 0.10000E+01 |
| | FORMC | : | 0.10000E+01 |
| | FORMKO | : | 0.10000E+01 |
| | DELD | : | 0.10000E-01 |
| NUMERICAL PARAMETERS | RMIN | : | 0.25000E-06 |
| | RMAX | : | 0.20000E-02 |
| | KMAX | : | 101 |
| | EPS | : | 0.10000E+00 |
| | CUTOFF | : | 0.10000E-14 |
| PROGRAM CONTROL PARAMETERS | SZEIT | : | 0.0 |
| | TIME | : | 100.00 |
| | CPUZT | : | 20.00 |
| | RESTRT | : | F |
| | ZWCOMP | : | F |
| | FOLGE | : | F |
| | GRAVK | : | T |
| | LEAK | : | T |
| | LKOND | : | F |
| | TIMEK1 | : | 0.50000E+06 |
| | TIMEK2 | : | 0.60000E+06 |
| OUTPUT CONTROL PARAMETERS | NWRITE | : | 10 |
| | | : | 100 |
| | NPLOT | : | 5 |

```
AEROSOL SOURCE FUNCTIONS CONTAINING  2 RELEASES AND  3 NUCLIDES
UP TO    5000.0 SEC
MODE1  1.00000E+06 (G)      RG  4.00000E-05 SIGL  7.00000E-01 RHO  4.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      2.00000E-02
NUCL 2      4.00000E-02
NUCL 3      0.0
MODE2  0.0          (G)      RG  4.00000E-05 SIGL  7.00000E-01 RHO  4.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      0.0
NUCL 2      0.0
NUCL 3      0.0
UP TO    6000.0 SEC
MODE1  5.00000E+05 (G)      RG  5.00000E-05 SIGL  8.00000E-01 RHO  3.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      0.0
NUCL 2      5.00000E-02
NUCL 3      3.00000E-02
MODE2  4.00000E+05 (G)      RG  6.00000E-05 SIGL  4.00000E-01 RHO  2.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      0.0
NUCL 2      8.00000E-02
NUCL 3      4.00000E-02
CONTAINMENTTEMPERATURE IN TIMESTEPS OF       1 SEC UP TO       0 SEC
  130.00
STEAMFLOW INTO THE CONTAINMENT AT    1 GRID POINTS

  TIME (SEC)   RATE (G/SEC)

 0.0           0.0
LEAKRATE OUT OF THE CONTAINMENT AT    1 GRID POINTS

  TIME (SEC)   RATE (1/SEC)

 0.0           0.11600E-06
```

**********************************************************************************************************************

TIME STEP # 100 1.5911 SEC PROBLEM TIME 132.70 SEC = 2.2 MIN = 0.0 HRS

| SPECIES | MASS CONCENTRATIONS (G/CM**3) | ACC. SEDI. DEPOSIT (G/CM**2) | ACC. DIFF. DEPOSIT (G/CM**2) | AIRBORNE MASSES (G) | ACC. LEAKED MASSES (G) |
|---|---|---|---|---|---|
| COND. WATER | 0.0 | 0.0 | 0.0 | 0.0 | |
| DRY PARTICLES | 0.132427E-04 | 0.718488E-03 | 0.247279E-07 | 0.953476E+06 | 0.150285E+02 |
| TOTAL | 0.132427E-04 | 0.718488E-03 | 0.247279E-07 | 0.953476E+06 | 0.150285E+02 |
| NUCL 1 | 0.264854E-06 | 0.143699E-04 | 0.494555E-09 | 0.190695E+05 | 0.300569E+00 |
| NUCL 2 | 0.529709E-06 | 0.287395E-04 | 0.989115E-09 | 0.381390E+05 | 0.601141E+00 |
| NUCL 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

PARTICLE CONC. = 1.25119E+06 (1/CM**3) AV. RADIUS = 0.5386 (MICRONS) AVERAGE DENSITY = 4.00 (G/CM**3)

LEAK RATE = 1.10563E-01 (G/SEC) CONT. TEMP. = 130.0 (DEG C) SATURATION RATIO = 1.00100
ACC.AER.SOURCE = 1.00000E+06 (G)

| K | PART.-RAD. (CM) | MASSDISTRIBUT. (G/CM**3) | NR.-DIST (1/CC) | SOLID MASS (G/CM**3) | H2O-MASS (G/CM**3) |
|---|---|---|---|---|---|
| 12 | 0.67186E-06 | 0.42610E-31 | 0.83858E-14 | 0.42610E-31 | 0.0 |
| 13 | 0.73504E-06 | 0.12070E-28 | 0.18140E-11 | 0.12070E-28 | 0.0 |
| 14 | 0.80416E-06 | 0.13605E-26 | 0.15614E-09 | 0.13605E-26 | 0.0 |
| 15 | 0.87978E-06 | 0.74740E-25 | 0.65509E-08 | 0.74740E-25 | 0.0 |
| 16 | 0.96251E-06 | 0.23232E-23 | 0.15550E-06 | 0.23232E-23 | 0.0 |
| 17 | 0.10530E-05 | 0.45717E-22 | 0.23368E-05 | 0.45717E-22 | 0.0 |
| 18 | 0.11520E-05 | 0.62080E-21 | 0.24233E-04 | 0.62080E-21 | 0.0 |
| 19 | 0.12604E-05 | 0.62214E-20 | 0.18546E-03 | 0.62214E-20 | 0.0 |
| 20 | 0.13789E-05 | 0.48518E-19 | 0.11045E-02 | 0.48518E-19 | 0.0 |
| 21 | 0.15086E-05 | 0.30712E-18 | 0.53397E-02 | 0.30712E-18 | 0.0 |
| 22 | 0.16504E-05 | 0.16327E-17 | 0.21678E-01 | 0.16327E-17 | 0.0 |
| 23 | 0.18056E-05 | 0.74918E-17 | 0.75962E-01 | 0.74918E-17 | 0.0 |
| 24 | 0.19754E-05 | 0.30344E-16 | 0.23495E+00 | 0.30344E-16 | 0.0 |
| 25 | 0.21612E-05 | 0.11048E-15 | 0.65328E+00 | 0.11048E-15 | 0.0 |
| 26 | 0.23644E-05 | 0.36709E-15 | 0.16576E+01 | 0.36709E-15 | 0.0 |
| 27 | 0.25867E-05 | 0.11269E-14 | 0.38861E+01 | 0.11269E-14 | 0.0 |
| 28 | 0.28299E-05 | 0.32294E-14 | 0.85045E+01 | 0.32294E-14 | 0.0 |
| 29 | 0.30961E-05 | 0.87122E-14 | 0.17521E+02 | 0.87122E-14 | 0.0 |
| 30 | 0.33872E-05 | 0.22284E-13 | 0.34224E+02 | 0.22284E-13 | 0.0 |
| 31 | 0.37057E-05 | 0.54357E-13 | 0.63753E+02 | 0.54357E-13 | 0.0 |
| 32 | 0.40542E-05 | 0.12706E-12 | 0.11381E+03 | 0.12706E-12 | 0.0 |
| 33 | 0.44354E-05 | 0.28581E-12 | 0.19550E+03 | 0.28581E-12 | 0.0 |
| 34 | 0.48525E-05 | 0.62080E-12 | 0.32428E+03 | 0.62080E-12 | 0.0 |
| 35 | 0.53088E-05 | 0.13058E-11 | 0.52088E+03 | 0.13058E-11 | 0.0 |
| 36 | 0.58080E-05 | 0.26658E-11 | 0.81211E+03 | 0.26658E-11 | 0.0 |
| 37 | 0.63542E-05 | 0.52936E-11 | 0.12315E+04 | 0.52936E-11 | 0.0 |
| 38 | 0.69517E-05 | 0.10242E-10 | 0.18196E+04 | 0.10242E-10 | 0.0 |
| 39 | 0.76054E-05 | 0.19332E-10 | 0.26229E+04 | 0.19332E-10 | 0.0 |
| 40 | 0.83205E-05 | 0.35647E-10 | 0.36933E+04 | 0.35647E-10 | 0.0 |
| 41 | 0.91030E-05 | 0.64276E-10 | 0.50859E+04 | 0.64276E-10 | 0.0 |
| 42 | 0.99589E-05 | 0.11344E-09 | 0.68547E+04 | 0.11344E-09 | 0.0 |
| 43 | 0.10895E-04 | 0.19610E-09 | 0.90491E+04 | 0.19610E-09 | 0.0 |
| 44 | 0.11920E-04 | 0.33224E-09 | 0.11708E+05 | 0.33224E-09 | 0.0 |
| 45 | 0.13041E-04 | 0.55205E-09 | 0.14856E+05 | 0.55205E-09 | 0.0 |
| 46 | 0.14267E-04 | 0.89992E-09 | 0.18496E+05 | 0.89992E-09 | 0.0 |
| 47 | 0.15609E-04 | 0.14401E-08 | 0.22603E+05 | 0.14401E-08 | 0.0 |
| 48 | 0.17077E-04 | 0.22632E-08 | 0.27126E+05 | 0.22632E-08 | 0.0 |
| 49 | 0.18682E-04 | 0.34937E-08 | 0.31978E+05 | 0.34937E-08 | 0.0 |
| 50 | 0.20439E-04 | 0.52996E-08 | 0.37043E+05 | 0.52996E-08 | 0.0 |
| 51 | 0.22361E-04 | 0.79013E-08 | 0.42177E+05 | 0.79013E-08 | 0.0 |
| 52 | 0.24464E-04 | 0.11581E-07 | 0.47211E+05 | 0.11581E-07 | 0.0 |
| 53 | 0.26764E-04 | 0.16690E-07 | 0.51961E+05 | 0.16690E-07 | 0.0 |
| 54 | 0.29281E-04 | 0.23654E-07 | 0.56239E+05 | 0.23654E-07 | 0.0 |
| 55 | 0.32034E-04 | 0.32971E-07 | 0.59861E+05 | 0.32971E-07 | 0.0 |
| 56 | 0.35047E-04 | 0.45197E-07 | 0.62664E+05 | 0.45197E-07 | 0.0 |
| 57 | 0.38342E-04 | 0.60933E-07 | 0.64515E+05 | 0.60933E-07 | 0.0 |
| 58 | 0.41948E-04 | 0.80783E-07 | 0.65318E+05 | 0.80783E-07 | 0.0 |
| 59 | 0.45892E-04 | 0.10531E-06 | 0.65027E+05 | 0.10531E-06 | 0.0 |
| 60 | 0.50208E-04 | 0.13498E-06 | 0.63647E+05 | 0.13498E-06 | 0.0 |
| 61 | 0.54929E-04 | 0.17006E-06 | 0.61241E+05 | 0.17006E-06 | 0.0 |
| 62 | 0.60095E-04 | 0.21058E-06 | 0.57912E+05 | 0.21058E-06 | 0.0 |

| | | | | | |
|---|---|---|---|---|---|
| 63 | 0.65745E-04 | 0.25621E-06 | 0.53815E+05 | 0.25621E-06 | 0.0 |
| 64 | 0.71928E-04 | 0.30633E-06 | 0.49135E+05 | 0.30633E-06 | 0.0 |
| 65 | 0.78692E-04 | 0.35983E-06 | 0.44076E+05 | 0.35983E-06 | 0.0 |
| 66 | 0.86091E-04 | 0.41523E-06 | 0.38841E+05 | 0.41523E-06 | 0.0 |
| 67 | 0.94187E-04 | 0.47072E-06 | 0.33626E+05 | 0.47072E-06 | 0.0 |
| 68 | 0.10304E-03 | 0.52425E-06 | 0.28598E+05 | 0.52425E-06 | 0.0 |
| 69 | 0.11273E-03 | 0.57364E-06 | 0.23898E+05 | 0.57364E-06 | 0.0 |
| 70 | 0.12333E-03 | 0.61679E-06 | 0.19622E+05 | 0.61679E-06 | 0.0 |
| 71 | 0.13493E-03 | 0.65178E-06 | 0.15835E+05 | 0.65178E-06 | 0.0 |
| 72 | 0.14762E-03 | 0.67702E-06 | 0.12561E+05 | 0.67702E-06 | 0.0 |
| 73 | 0.16150E-03 | 0.69136E-06 | 0.97961E+04 | 0.69136E-06 | 0.0 |
| 74 | 0.17669E-03 | 0.69427E-06 | 0.75123E+04 | 0.69427E-06 | 0.0 |
| 75 | 0.19330E-03 | 0.68565E-06 | 0.56656E+04 | 0.68565E-06 | 0.0 |
| 76 | 0.21148E-03 | 0.66599E-06 | 0.42025E+04 | 0.66599E-06 | 0.0 |
| 77 | 0.23137E-03 | 0.63631E-06 | 0.30665E+04 | 0.63631E-06 | 0.0 |
| 78 | 0.25312E-03 | 0.59788E-06 | 0.22003E+04 | 0.59788E-06 | 0.0 |
| 79 | 0.27693E-03 | 0.55242E-06 | 0.15526E+04 | 0.55242E-06 | 0.0 |
| 80 | 0.30297E-03 | 0.50179E-06 | 0.10770E+04 | 0.50179E-06 | 0.0 |
| 81 | 0.33146E-03 | 0.44794E-06 | 0.73419E+03 | 0.44794E-06 | 0.0 |
| 82 | 0.36262E-03 | 0.39278E-06 | 0.49164E+03 | 0.39278E-06 | 0.0 |
| 83 | 0.39672E-03 | 0.33811E-06 | 0.32320E+03 | 0.33811E-06 | 0.0 |
| 84 | 0.43403E-03 | 0.28554E-06 | 0.20846E+03 | 0.28554E-06 | 0.0 |
| 85 | 0.47484E-03 | 0.23636E-06 | 0.13177E+03 | 0.23636E-06 | 0.0 |
| 86 | 0.51949E-03 | 0.19159E-06 | 0.81562E+02 | 0.19159E-06 | 0.0 |
| 87 | 0.56834E-03 | 0.15188E-06 | 0.49378E+02 | 0.15188E-06 | 0.0 |
| 88 | 0.62179E-03 | 0.11761E-06 | 0.29199E+02 | 0.11761E-06 | 0.0 |
| 89 | 0.68026E-03 | 0.88820E-07 | 0.16840E+02 | 0.88820E-07 | 0.0 |
| 90 | 0.74423E-03 | 0.65312E-07 | 0.94567E+01 | 0.65312E-07 | 0.0 |
| 91 | 0.81421E-03 | 0.46660E-07 | 0.51594E+01 | 0.46660E-07 | 0.0 |
| 92 | 0.89077E-03 | 0.32311E-07 | 0.27285E+01 | 0.32311E-07 | 0.0 |
| 93 | 0.97454E-03 | 0.21629E-07 | 0.13948E+01 | 0.21629E-07 | 0.0 |
| 94 | 0.10662E-02 | 0.13951E-07 | 0.68707E+00 | 0.13951E-07 | 0.0 |
| 95 | 0.11664E-02 | 0.86372E-08 | 0.32484E+00 | 0.86372E-08 | 0.0 |
| 96 | 0.12761E-02 | 0.51086E-08 | 0.14672E+00 | 0.51086E-08 | 0.0 |
| 97 | 0.13961E-02 | 0.28708E-08 | 0.62964E-01 | 0.28708E-08 | 0.0 |
| 98 | 0.15274E-02 | 0.15227E-08 | 0.25504E-01 | 0.15227E-08 | 0.0 |
| 99 | 0.16710E-02 | 0.75613E-09 | 0.96719E-02 | 0.75613E-09 | 0.0 |
| 100 | 0.18282E-02 | 0.34810E-09 | 0.34003E-02 | 0.34810E-09 | 0.0 |
| 101 | 0.20000E-02 | 0.16485E-09 | 0.12298E-02 | 0.16485E-09 | 0.0 |

********************************************************************************************************************************************

TIME STEP # 1900          8.6900 SEC          PROBLEM TIME  10086.10 SEC =   168.1 MIN =   2.8 HRS

| SPECIES | MASS CONCENTRATIONS (G/CM**3) | ACC. SEDI. DEPOSIT (G/CM**2) | ACC. DIFF. DEPOSIT (G/CM**2) | AIRBORNE MASSES (G) | ACC. LEAKED MASSES (G) |
|---|---|---|---|---|---|
| COND. WATER | 0.0 | 0.0 | 0.0 | 0.0 | |
| DRY PARTICLES | 0.587588E-05 | 0.228155E-01 | 0.113156E-05 | 0.423063E+06 | 0.749920E+03 |
| TOTAL | 0.587588E-05 | 0.228155E-01 | 0.113156E-05 | 0.423063E+06 | 0.749920E+03 |
| NUCL 1 | 0.297404E-07 | 0.275904E-03 | 0.133354E-07 | 0.214[illegible]31E+04 | 0.860594E+01 |
| NUCL 2 | 0.337442E-06 | 0.112304E-02 | 0.561121E-07 | 0.242958E+05 | 0.374572E+02 |
| NUCL 3 | 0.151172E-06 | 0.310671E-03 | 0.160097E-07 | 0.108844E+05 | 0.110124E+02 |

PARTICLE CONC. = 1.96149E+05 (1/CM**3)      AV. RADIUS  =  1.0969 (MICRONS)   AVERAGE DENSITY  =  2.72 (G/CM**3)

LEAK RATE       = 4.91580E-02 (G/SEC)       CONT. TEMP. = 130.0 (DEG C)       SATURATION RATIO =  1.00100
ACC.AER.SOURCE = 1.90000E+06 (G)

| K | PART.-RAD. (CM) | MASSDISTRIBUT. (G/CM**3) | NR.-DIST (1/CC) | SOLID MASS (G/CM**3) | H2O-MASS (G/CM**3) |
|---|---|---|---|---|---|
| 31 | 0.37057E-05 | 0.60692E-28 | 0.10470E-12 | 0.60692E-28 | 0.0 |
| 32 | 0.40542E-05 | 0.80013E-26 | 0.10552E-10 | 0.80013E-26 | 0.0 |
| 33 | 0.44354E-05 | 0.55581E-24 | 0.55959E-09 | 0.55581E-24 | 0.0 |
| 34 | 0.48525E-05 | 0.22489E-22 | 0.17286E-07 | 0.22489E-22 | 0.0 |
| 35 | 0.53088E-05 | 0.57650E-21 | 0.33836E-06 | 0.57650E-21 | 0.0 |
| 36 | 0.58080E-05 | 0.10042E-19 | 0.45004E-05 | 0.10042E-19 | 0.0 |
| 37 | 0.63542E-05 | 0.12597E-18 | 0.43109E-04 | 0.12597E-18 | 0.0 |
| 38 | 0.69517E-05 | 0.11946E-17 | 0.31218E-03 | 0.11946E-17 | 0.0 |
| 39 | 0.76054E-05 | 0.89206E-17 | 0.17802E-02 | 0.89206E-17 | 0.0 |
| 40 | 0.83205E-05 | 0.54283E-16 | 0.82722E-02 | 0.54283E-16 | 0.0 |
| 41 | 0.91030E-05 | 0.27709E-15 | 0.32247E-01 | 0.27709E-15 | 0.0 |
| 42 | 0.99589E-05 | 0.12153E-14 | 0.10813E+00 | 0.12153E-14 | 0.0 |
| 43 | 0.10895E-04 | 0.46923E-14 | 0.31869E+00 | 0.46923E-14 | 0.0 |
| 44 | 0.11920E-04 | 0.16233E-13 | 0.84172E+00 | 0.16233E-13 | 0.0 |
| 45 | 0.13041E-04 | 0.51218E-13 | 0.20279E+01 | 0.51218E-13 | 0.0 |
| 46 | 0.14267E-04 | 0.14986E-12 | 0.45308E+01 | 0.14986E-12 | 0.0 |
| 47 | 0.15609E-04 | 0.41307E-12 | 0.95371E+01 | 0.41307E-12 | 0.0 |
| 48 | 0.17077E-04 | 0.10885E-11 | 0.19192E+02 | 0.10885E-11 | 0.0 |
| 49 | 0.18682E-04 | 0.27759E-11 | 0.37373E+02 | 0.27759E-11 | 0.0 |
| 50 | 0.20439E-04 | 0.69014E-11 | 0.70951E+02 | 0.69014E-11 | 0.0 |
| 51 | 0.22361E-04 | 0.16762E-10 | 0.13160E+03 | 0.16762E-10 | 0.0 |
| 52 | 0.24464E-04 | 0.39608E-10 | 0.23771E+03 | 0.39608E-10 | 0.0 |
| 53 | 0.26764E-04 | 0.90703E-10 | 0.41559E+03 | 0.90703E-10 | 0.0 |
| 54 | 0.29281E-04 | 0.19956E-09 | 0.69812E+03 | 0.19956E-09 | 0.0 |
| 55 | 0.32034E-04 | 0.41940E-09 | 0.11204E+04 | 0.41940E-09 | 0.0 |
| 56 | 0.35047E-04 | 0.83922E-09 | 0.17119E+04 | 0.83922E-09 | 0.0 |
| 57 | 0.38342E-04 | 0.15977E-08 | 0.24885E+04 | 0.15977E-08 | 0.0 |
| 58 | 0.41948E-04 | 0.28989E-08 | 0.34478E+04 | 0.28989E-08 | 0.0 |
| 59 | 0.45892E-04 | 0.50316E-08 | 0.45702E+04 | 0.50316E-08 | 0.0 |
| 60 | 0.50208E-04 | 0.83955E-08 | 0.58236E+04 | 0.83956E-08 | 0.0 |
| 61 | 0.54929E-04 | 0.13534E-07 | 0.71690E+04 | 0.13534E-07 | 0.0 |
| 62 | 0.60095E-04 | 0.21170E-07 | 0.85629E+04 | 0.21170E-07 | 0.0 |
| 63 | 0.65745E-04 | 0.32220E-07 | 0.99558E+04 | 0.32220E-07 | 0.0 |
| 64 | 0.71928E-04 | 0.47840E-07 | 0.11288E+05 | 0.47840E-07 | 0.0 |
| 65 | 0.78692E-04 | 0.69303E-07 | 0.12488E+05 | 0.69303E-07 | 0.0 |
| 66 | 0.86091E-04 | 0.97883E-07 | 0.13470E+05 | 0.97883E-07 | 0.0 |
| 67 | 0.94187E-04 | 0.13453E-06 | 0.14138E+05 | 0.13453E-06 | 0.0 |
| 68 | 0.10304E-03 | 0.17940E-06 | 0.14399E+05 | 0.17940E-06 | 0.0 |
| 69 | 0.11273E-03 | 0.23129E-06 | 0.14176E+05 | 0.23129E-06 | 0.0 |
| 70 | 0.12333E-03 | 0.28703E-06 | 0.13434E+05 | 0.28703E-06 | 0.0 |
| 71 | 0.13493E-03 | 0.34159E-06 | 0.12269E+05 | 0.34159E-06 | 0.0 |
| 72 | 0.14762E-03 | 0.38873E-06 | 0.10610E+05 | 0.38873E-06 | 0.0 |
| 73 | 0.16150E-03 | 0.42261E-06 | 0.88097E+04 | 0.42261E-06 | 0.0 |
| 74 | 0.17669E-03 | 0.43957E-06 | 0.69977E+04 | 0.43957E-06 | 0.0 |
| 75 | 0.19330E-03 | 0.43898E-06 | 0.53366E+04 | 0.43898E-06 | 0.0 |
| 76 | 0.21148E-03 | 0.42307E-06 | 0.39276E+04 | 0.42307E-06 | 0.0 |
| 77 | 0.23137E-03 | 0.39568E-06 | 0.28053E+04 | 0.39567E-06 | 0.0 |
| 78 | 0.25312E-03 | 0.36061E-06 | 0.19526E+04 | 0.36061E-06 | 0.0 |
| 79 | 0.27693E-03 | 0.32114E-06 | 0.13279E+04 | 0.32114E-06 | 0.0 |
| 80 | 0.30297E-03 | 0.27956E-06 | 0.88279E+03 | 0.27956E-06 | 0.0 |
| 81 | 0.33146E-03 | 0.23743E-06 | 0.57258E+03 | 0.23743E-06 | 0.0 |

| | | | | | |
|---|---|---|---|---|---|
| 82 | 0.36262E-03 | 0.19594E-06 | 0.36085E+03 | 0.19594E-06 | 0.0 |
| 83 | 0.39672E-03 | 0.15617E-06 | 0.21965E+03 | 0.15617E-06 | 0.0 |
| 84 | 0.43403E-03 | 0.11927E-06 | 0.12810E+03 | 0.11927E-06 | 0.0 |
| 85 | 0.47484E-03 | 0.86431E-07 | 0.70892E+02 | 0.86431E-07 | 0.0 |
| 86 | 0.51949E-03 | 0.58750E-07 | 0.36799E+02 | 0.58750E-07 | 0.0 |
| 87 | 0.56834E-03 | 0.36956E-07 | 0.17677E+02 | 0.36956E-07 | 0.0 |
| 88 | 0.62179E-03 | 0.21183E-07 | 0.77379E+01 | 0.21183E-07 | 0.0 |
| 89 | 0.68026E-03 | 0.10868E-07 | 0.30320E+01 | 0.10868E-07 | 0.0 |
| 90 | 0.74423E-03 | 0.48941E-08 | 0.10426E+01 | 0.48941E-08 | 0.0 |
| 91 | 0.81421E-03 | 0.18938E-08 | 0.30810E+00 | 0.18938E-08 | 0.0 |
| 92 | 0.89077E-03 | 0.61605E-09 | 0.76539E-01 | 0.61605E-09 | 0.0 |
| 93 | 0.97454E-03 | 0.16492E-09 | 0.15647E-01 | 0.16492E-09 | 0.0 |
| 94 | 0.10662E-02 | 0.35625E-10 | 0.25814E-02 | 0.35625E-10 | 0.0 |
| 95 | 0.11664E-02 | 0.61061E-11 | 0.33788E-03 | 0.61061E-11 | 0.0 |
| 96 | 0.12761E-02 | 0.81930E-12 | 0.34621E-04 | 0.81930E-12 | 0.0 |
| 97 | 0.13961E-02 | 0.85171E-13 | 0.27485E-05 | 0.85171E-13 | 0.0 |
| 98 | 0.15274E-02 | 0.68070E-14 | 0.16776E-06 | 0.68070E-14 | 0.0 |
| 99 | 0.16710E-02 | 0.41585E-15 | 0.78265E-08 | 0.41585E-15 | 0.0 |
| 100 | 0.18282E-02 | 0.19337E-16 | 0.27792E-09 | 0.19337E-16 | 0.0 |
| 101 | 0.20000E-02 | 0.70603E-18 | 0.77502E-11 | 0.70603E-18 | 0.0 |

************************************************************************************************************************

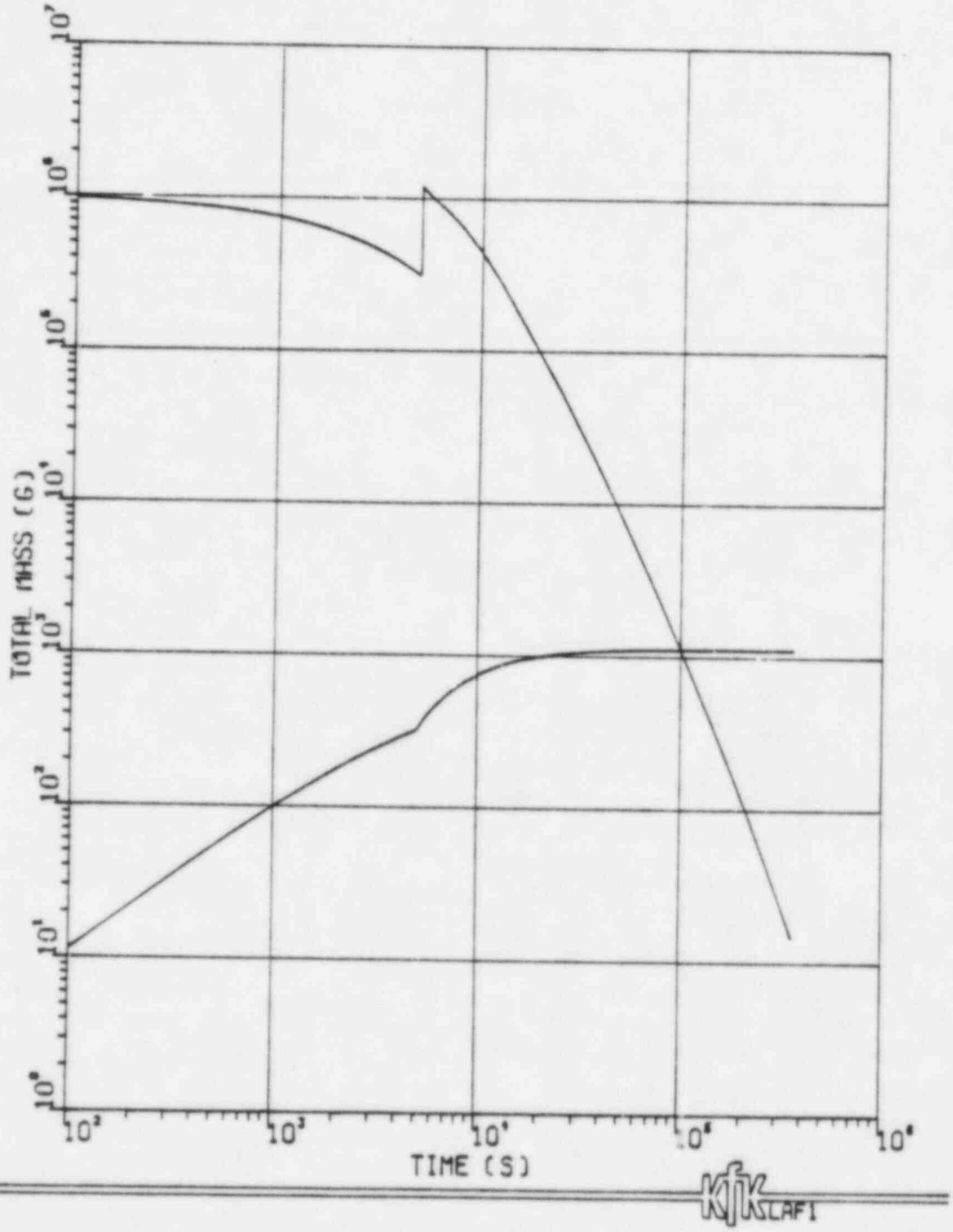
TIME STEP # 4688 811.7292 SEC PROBLEM TIME 360024.19 SEC = 6000.4 MIN = 100.0 HRS

| SPECIES | MASS CONCENTRATIONS (G/CM**3) | ACC. SEDI. DEPOSIT (G/CM**2) | ACC. DIFF. DEPOSIT (G/CM**2) | AIRBORNE MASSES (G) | ACC. LEAKED MASSES (G) |
|---|---|---|---|---|---|
| COND. WATER | 0.0 | 0.0 | 0.0 | 0.0 | |
| DRY PARTICLES | 0.194028E-09 | 0.293463E-01 | 0.165637E-05 | 0.139700E+02 | 0.110480E+04 |
| TOTAL | 0.194028E-09 | 0.293463E-01 | 0.165637E-05 | 0.139700E+02 | 0.110480E+04 |
| NUCL 1 | 0.982061E-12 | 0.308685E-03 | 0.159930E-07 | 0.707083E-01 | 0.104025E+02 |
| NUCL 2 | 0.111427E-10 | 0.149807E-02 | 0.862463E-07 | 0.802273E+00 | 0.578358E+02 |
| NUCL 3 | 0.499185E-11 | 0.478509E-03 | 0.295391E-07 | 0.359413E+00 | 0.201353E+02 |

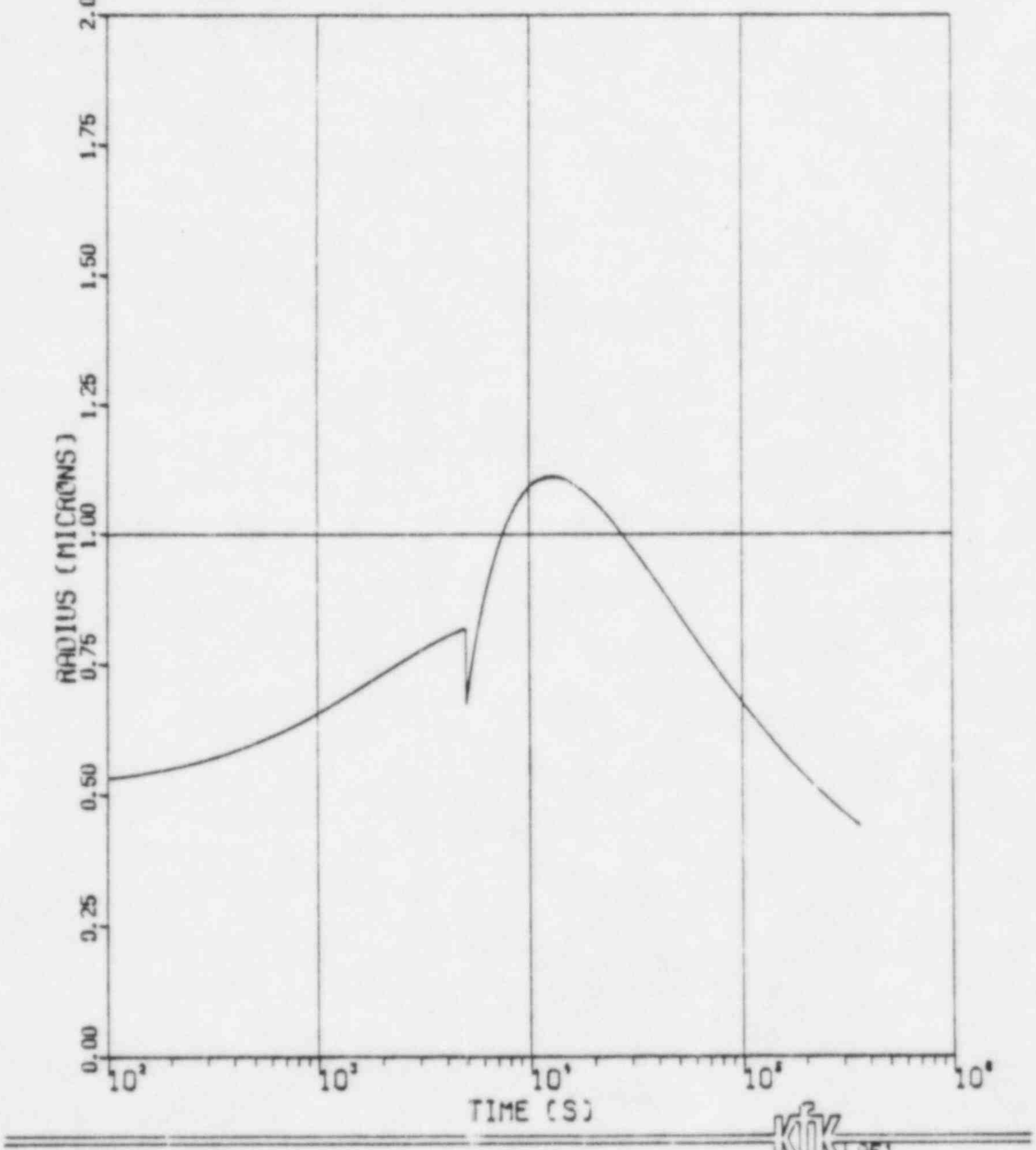
PARTICLE CONC. = 1.67496E+02 (1/CM**3) AV. RADIUS = 0.4378 (MICRONS) AVERAGE DENSITY = 2.72 (G/CM**3)

LEAK RATE = 1.63451E-06 (G/SEC) CONT. TEMP. = 130.0 (DEG C) SATURATION RATIO = 1.00100
ACC.AER.SOURCE = 1.90000E+06 (G)

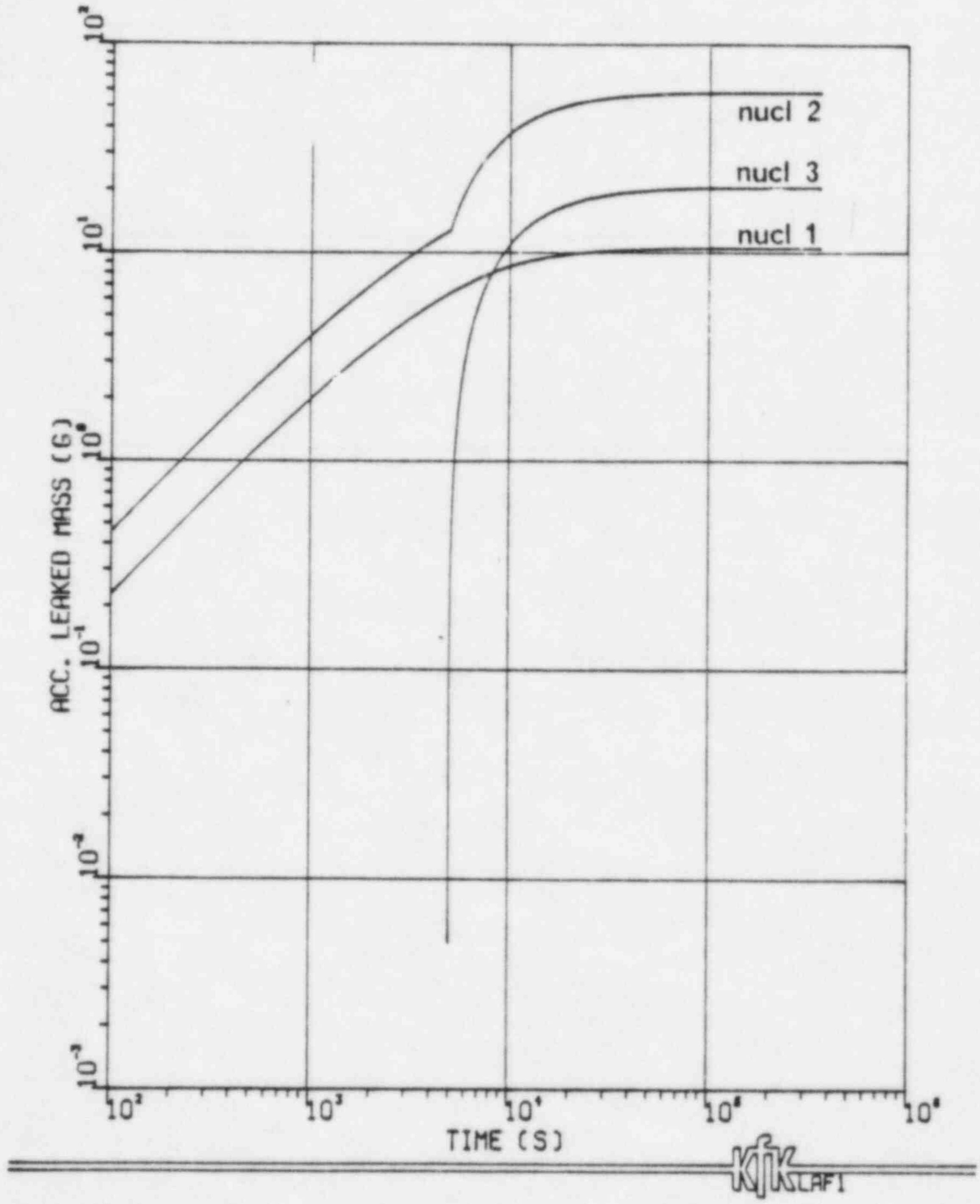
| K | PART.-RAD. (CM) | MASSDISTRIBUT. (G/CM**3) | NR.-DIST (1/CC) | SOLID MASS (G/CM**3) | H2O-MASS (G/CM**3) |
|---|---|---|---|---|---|
| 35 | 0.53088E-05 | 0.12472E-28 | 0.73278E-14 | 0.12472E-28 | 0.0 |
| 36 | 0.58080E-05 | 0.15604E-26 | 0.69994E-12 | 0.15604E-26 | 0.0 |
| 37 | 0.63542E-05 | 0.10708E-24 | 0.36676E-10 | 0.10708E-24 | 0.0 |
| 38 | 0.69517E-05 | 0.44059E-23 | 0.11522E-08 | 0.44059E-23 | 0.0 |
| 39 | 0.76054E-05 | 0.11712E-21 | 0.23386E-07 | 0.11712E-21 | 0.0 |
| 40 | 0.83205E-05 | 0.21415E-20 | 0.32652E-06 | 0.21415E-20 | 0.0 |
| 41 | 0.91030E-05 | 0.28396E-19 | 0.33064E-05 | 0.28396E-19 | 0.0 |
| 42 | 0.99589E-05 | 0.28483E-18 | 0.25399E-04 | 0.28483E-18 | 0.0 |
| 43 | 0.10895E-04 | 0.22582E-17 | 0.15364E-03 | 0.22582E-17 | 0.0 |
| 44 | 0.11920E-04 | 0.14578E-16 | 0.75697E-03 | 0.14578E-16 | 0.0 |
| 45 | 0.13041E-04 | 0.78836E-16 | 0.31249E-02 | 0.78836E-16 | 0.0 |
| 46 | 0.14267E-04 | 0.36669E-15 | 0.11097E-01 | 0.36669E-15 | 0.0 |
| 47 | 0.15609E-04 | 0.15006E-14 | 0.34674E-01 | 0.15006E-14 | 0.0 |
| 48 | 0.17077E-04 | 0.55160E-14 | 0.97331E-01 | 0.55160E-14 | 0.0 |
| 49 | 0.18682E-04 | 0.18513E-13 | 0.24940E+00 | 0.18513E-13 | 0.0 |
| 50 | 0.20439E-04 | 0.57320E-13 | 0.58965E+00 | 0.57320E-13 | 0.0 |
| 51 | 0.22361E-04 | 0.16441E-12 | 0.12916E+01 | 0.16441E-12 | 0.0 |
| 52 | 0.24464E-04 | 0.43539E-12 | 0.26194E+01 | 0.43539E-12 | 0.0 |
| 53 | 0.26764E-04 | 0.10596E-11 | 0.48634E+01 | 0.10596E-11 | 0.0 |
| 54 | 0.29281E-04 | 0.23457E-11 | 0.82140E+01 | 0.23457E-11 | 0.0 |
| 55 | 0.32034E-04 | 0.46892E-11 | 0.12538E+02 | 0.46892E-11 | 0.0 |
| 56 | 0.35047E-04 | 0.84062E-11 | 0.17162E+02 | 0.84062E-11 | 0.0 |
| 57 | 0.38342E-04 | 0.13458E-10 | 0.20979E+02 | 0.13458E-10 | 0.0 |
| 58 | 0.41948E-04 | 0.19206E-10 | 0.22861E+02 | 0.19206E-10 | 0.0 |
| 59 | 0.45892E-04 | 0.24422E-10 | 0.22198E+02 | 0.24422E-10 | 0.0 |
| 60 | 0.50208E-04 | 0.27623E-10 | 0.19172E+02 | 0.27623E-10 | 0.0 |
| 61 | 0.54929E-04 | 0.27675E-10 | 0.14668E+02 | 0.27675E-10 | 0.0 |
| 62 | 0.60095E-04 | 0.24325E-10 | 0.98451E+01 | 0.24325E-10 | 0.0 |
| 63 | 0.65745E-04 | 0.18514E-10 | 0.57272E+01 | 0.18514E-10 | 0.0 |
| 64 | 0.71928E-04 | 0.11852E-10 | 0.27996E+01 | 0.11852E-10 | 0.0 |
| 65 | 0.78692E-04 | 0.62093E-11 | 0.11200E+01 | 0.62093E-11 | 0.0 |
| 66 | 0.86091E-04 | 0.25614E-11 | 0.35280E+00 | 0.25614E-11 | 0.0 |
| 67 | 0.94187E-04 | 0.79416E-12 | 0.83525E-01 | 0.79416E-12 | 0.0 |
| 68 | 0.10304E-03 | 0.17499E-12 | 0.14054E-01 | 0.17499E-12 | 0.0 |
| 69 | 0.11273E-03 | 0.25637E-13 | 0.15723E-02 | 0.25637E-13 | 0.0 |
| 70 | 0.12333E-03 | 0.23096E-14 | 0.10817E-03 | 0.23096E-14 | 0.0 |
| 71 | 0.13493E-03 | 0.11705E-15 | 0.41864E-05 | 0.11705E-15 | 0.0 |
| 72 | 0.14762E-03 | 0.30242E-17 | 0.82598E-07 | 0.30242E-17 | 0.0 |
| 73 | 0.16150E-03 | 0.36218E-19 | 0.75554E-09 | 0.36218E-19 | 0.0 |
| 74 | 0.17669E-03 | 0.18508E-21 | 0.29487E-11 | 0.18508E-21 | 0.0 |
| 75 | 0.19330E-03 | 0.39463E-24 | 0.48016E-14 | 0.39463E-24 | 0.0 |



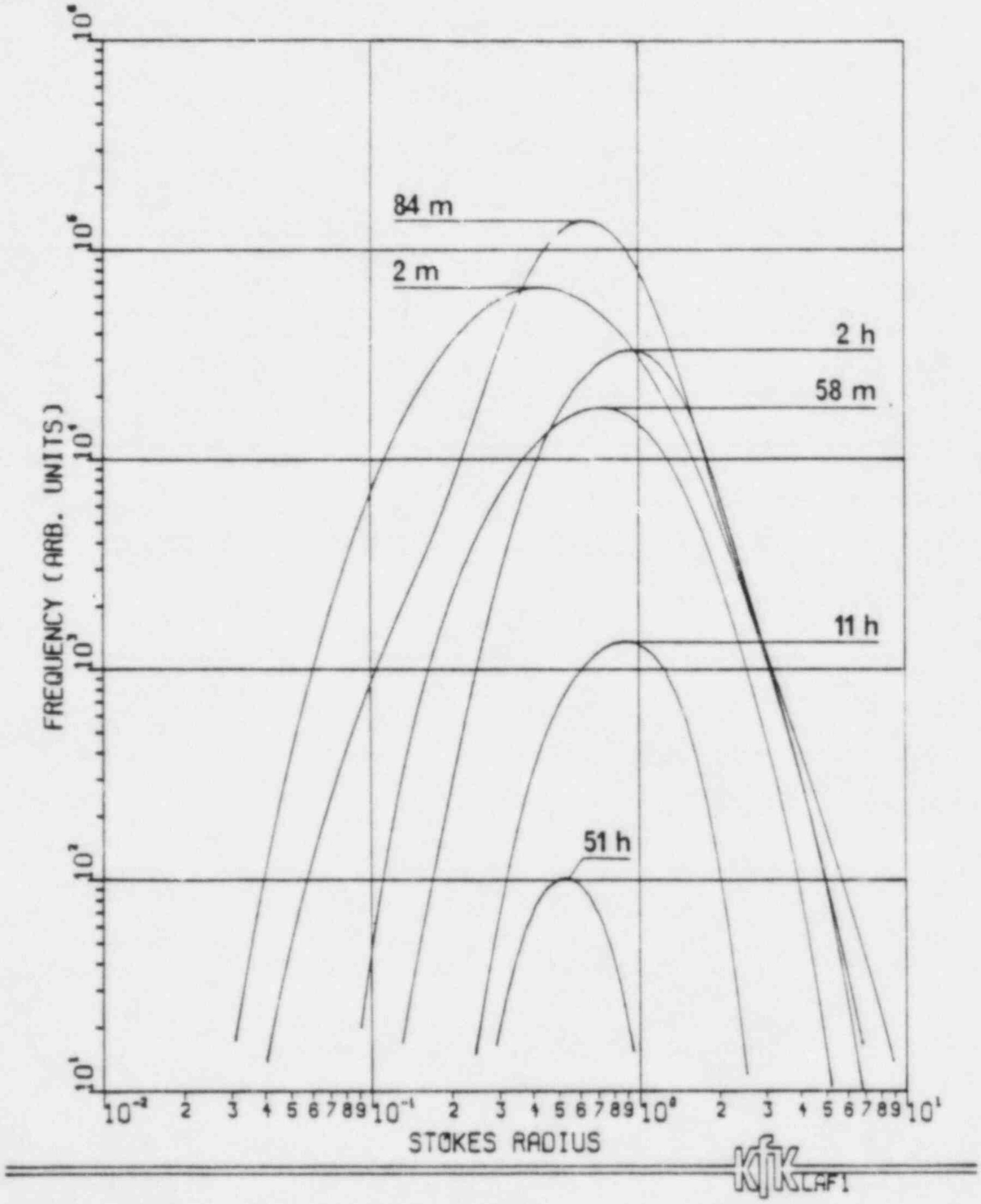

AIRBØRNE AND ACC. LEAKED MASSES




AVERAGE PARTICLE RADIUS




ACCUMULATED LEAKED NUCLIDES




PARTICLE SIZE DISTRIBUTIONS

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//LAF295E2 JOB (0295,691,P4311),KOYRO,NOTIFY=LAF295,TIME=120
//*MAIN LINES=30
//E2  EXEC F7CG
//C.SYSPRINT DD DUMMY
//C.SYSIN     DD  DISP=SHR,DSN=TS0657.NAUAMOD4.FORT
//G.FT01F001 DD DSN=LAF295.L.LIST,UNIT=DISK,VOL=SER=BAT00H,DCB=DCB.VBS,
//   DISP=(,CATLG),SPACE=(CYL,(20,5),RLSE)
//G.FT02F001  DD  DUMMY
//G.FT03F001  DD  UNIT=DISK,VOL=SER=BAT00H,DISP=(,CATLG),
//   DSN=LAF295.E23.DATA,SPACE=(TRK,(20,5)),DCB=DCB.VBS
//G.FT08F001  DD  UNIT=DISK,VOL=SER=BAT00H,DISP=(,CATLG),
//   DSN=LAF295.E28.DATA,SPACE=(TRK,(20,5)),DCB=DCB.VBS
//G.FT09F001 DD DSN=LAF295.REST2,UNIT=DISK,VOL=SER=BAT00H,DCB=DCB.VBS,
//   DISP=(,CATLG),SPACE=(TRK,(1,1))
//G.FT10F001  DD  DUMMY
//G.FT19F001 DD DSN=&&CPUZEIT,UNIT=SYSDA,DCB=DCB.VBS,DISP=(,PASS)
//G.SYSIN     DD  *
 NAUA SAMPLE CASE # 2-------------------------------------------
 CONTAINMENT, BEST ESTIMATE AEROSOL SOURCE, STEAM, GRAVK -----------
72000.E6  6460.E4  50540.E4
1.  1.  1.  0.01
0.0025E-4  50.E-4  101  0.1  1.E-15
0. 100.  120.
.F. .F.  .T.  .T.  .T.
.T.  0. 0. 1846. 12462.
20  200  5
 5  1
   170.94 .T.  .1E-4  .29 8.
       0.  .F.  .1E-4  .29 8.  1170.
'NUCL 1'  .05  0
   350.26 .T.  .1E-4  .29 8.
       0.  .F.  .1E-4  .29 8.  2026.5
'NUCL 1'  .05  0
   956.94 .T.  .1E-4  .29 8.
       0.  .F.  .1E-4  .29 8.  2340.
'NUCL 1'  .05  0
       0.  .F.  .1E-4  .29 8.
       0.  .F.  .1E-4  .29 8.  8580.
'NUCL 1'  .0   0
   111.11 .T.  .1E-4  .29 8.
    61.11 .T. 1.66E-4 .77 2.5 10380.
'NUCL 1'  .05  0
1  1.
130./
4
1846. 5088.38
4615. 36279.07
5607. -7295.01
12461. 0.
   1
   0.   .11574E-6
/*
```

```
//E2S2 EXEC F7CG
//C.SYSPRINT DD DUMMY
//C.SYSIN DD DSN=TS0657.NAUAMOD4.FORT,DISP=SHR
//G.FT01F001 DD DUMMY
//G.FT02F001 DD DSN=*.E2.G.FT01F001,DISP=SHR
//G.FT03F001  DD  UNIT=DISK,VOL=SER=BAT00H,DISP=(,CATLG),
//    DSN=LAF295.E2S23.DATA,SPACE=(TRK,(20,5)),DCB=DCB.VBS
//G.FT08F001  DD  UNIT=DISK,VOL=SER=BAT00H,DISP=(,CATLG),
//    DSN=LAF295.E2S28.DATA,SPACE=(TRK,(20,5)),DCB=DCB.VBS
//G.FT09F001 DD DSN=LAF295.REST2S2,UNIT=DISK,VOL=SER=BAT00H,
//    DCB=DCB.VBS,DISP=(,CATLG),SPACE=(TRK,(1,1))
//G.FT10F001 DD DUMMY
//G.FT19F001 DD DSN=*.D4.G.FT19F001,DISP=(OLD,DELETE)
//G.SYSIN DD *
 NAUA SAMPLE CASE # 2---------------------------------------------
 ANNULAR GAP, AEROSOL SOURCE = LEAK OF CONTAINMENT, NO STEAM, GRAVK --
   1.4675E10 2.564E7 2.36235E8
1.  1.  1.  0.01
0.0025E-4  50.E-4  101  0.1  1.E-15
0. 100.  120.
.F. .T. .F.  .T.  .T.
.F.  0.    0.  0.  0.
10  100  5
   1  1
   0.      .F.  1   1  1
   0.      .F.  1   1  1   0.
   'NUCL 1'  0.      0.
1  1.
130./
1
0.  0.
   1
   0.   .5E-6
//
```

```
NAUA - MOD4          INPUT DATA LISTING
****************************************


TEXT :  NAUA SAMPLE CASE # 2-----------------------------------------------
        CONTAINMENT, BEST ESTIMATE AEROSOL SOURCE, STEAM, GRAVK -------


CONTROL VOLUME PARAMETERS      VOL    : 0.72000E+11
                               FSED   : 0.64600E+08
                               FDIFF  : 0.50540E+09

AEROSOL PROCESS PARAMETERS     FORM   : 0.10000E+01
                               FORMC  : 0.10000E+01
                               FORMKO : 0.10000E+01
                               DELD   : 0.10000E-01

NUMERICAL PARAMETERS           RMIN   : 0.25000E-06
                               RMAX   : 0.50000E-02
                               KMAX   :         101
                               EPS    : 0.10000E+00
                               CUTOFF : 0.10000E-14

PROGRAM CONTROL PARAMETERS     SZEIT  :        0.0
                               TIME   :     100.00
                               CPUZT  :     120.00
                               RESTRT :  F
                               ZWCOMP :  F
                               FOLGE  :  T
                               GRAVK  :  T
                               LEAK   :  T
                               LKOND  :  T
                               TIMEK1 : 0.0
                               TIMEK2 : 0.0
                               TIMEK3 : 0.18460E+04
                               TIMEK4 : 0.12462E+05

OUTPUT CONTROL PARAMETERS      NWRITE :          20
                                      :         200
                               NPLOT  :           5
```

```
AEROSOL SOURCE FUNCTIONS CONTAINING  5 RELEASES AND  1 NUCLIDES
UP TO    1170.0 SEC
MODE1  1.70940E+02 (G/SEC) RG  1.00000E-05 SIGL  2.90000E-01 RHO  8.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      5.00000E-02
MODE2  0.0          (G)     RG  1.00000E-05 SIGL  2.90000E-01 RHO  8.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      0.0
UP TO    2026.5 SEC
MODE1  3.50260E+02 (G/SEC) RG  1.00000E-05 SIGL  2.90000E-01 RHO  8.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      5.00000E-02
MODE2  0.0          (G)     RG  1.00000E-05 SIGL  2.90000E-01 RHO  8.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      0.0
UP TO    2340.0 SEC
MODE1  9.56940E+02 (G/SEC) RG  1.00000E-05 SIGL  2.90000E-01 RHO  8.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      5.00000E-02
MODE2  0.0          (G)     RG  1.00000E-05 SIGL  2.90000E-01 RHO  8.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      0.0
UP TO    8580.0 SEC
MODE1  0.0          (G)     RG  1.00000E-05 SIGL  2.90000E-01 RHO  8.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      0.0
MODE2  0.0          (G)     RG  1.00000E-05 SIGL  2.90000E-01 RHO  8.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      0.0
UP TO   10380.0 SEC
MODE1  1.11110E+02 (G/SEC) RG  1.00000E-05 SIGL  2.90000E-01 RHO  8.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      5.00000E-02
MODE2  6.11100E+01 (G/SEC) RG  1.66000E-04 SIGL  7.70000E-01 RHO  2.500
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      0.0
CONTAINMENTTEMPERATURE IN TIMESTEPS OF       1 SEC UP TO       0 SEC
  130.00
STEAMFLOW INTO THE CONTAINMENT AT   4 GRID POINTS

   TIME (SEC)    RATE (G/SEC)

 0.18460E+04   0.50884E+04
 0.46150E+04   0.36279E+05
 0.56070E+04  -0.72950E+04
 0.12461E+05   0.0
LEAKRATE OUT OF THE CONTAINMENT AT     1 GRID POINTS

   TIME (SEC)    RATE (1/SEC)

 0.0           0.11574E-06
```

TIME STEP # 1355 1.1820 SEC PROBLEM TIME 1807.43 SEC = 30.1 MIN = 0.5 HRS

| SPECIES | MASS CONCENTRATIONS (G/CM**3) | ACC. SEDI. DEPOSIT (G/CM**2) | ACC. DIFF. DEPOSIT (G/CM**2) | AIRBORNE MASSES (G) | ACC. LEAKED MASSES (G) |
|---|---|---|---|---|---|
| COND. WATER | 0.0 | 0.0 | 0.0 | 0.0 | |
| DRY PARTICLES | 0.581572E-05 | 0.607892E-04 | 0.358691E-06 | 0.418732E+06 | 0.362856E+02 |
| TOTAL | 0.581572E-05 | 0.607892E-04 | 0.358691E-06 | 0.418732E+06 | 0.362856E+02 |
| NUCL 1 | 0.290744E-06 | 0.303904E-05 | 0.179324E-07 | 0.209336E+05 | 0.181407E+01 |

PARTICLE CONC. = 1.20006E+07 (1/CM**3) AV. RADIUS = 0.1769 (MICRONS) AVERAGE DENSITY = 8.00 (G/CM**3)

LEAK RATE = 4.84652E-02 (G/SEC) CONT. TEMP. = 130.0 (DEG C) SATURATION RATIO = 1.00100
ACC.AER.SOURCE = 4.23172E+05 (G)

START OF CONDENSATION AT A TIME OF 1.84642E+03 SEC, A TEMP. OF 130.0 C , AND A STEAM CONTENT OF 1.49866E-03 G/CM**3

********************************************************************************************************************************

TIME STEP # 2758    4.5399 SEC    PROBLEM TIME 3973.72 SEC = 66.2 MIN = 1.1 HRS

| SPECIES | MASS CONCENTRATIONS (G/CM**3) | ACC. SEDI. DEPOSIT (G/CM**2) | ACC. DIFF. DEPOSIT (G/CM**2) | AIRBORNE MASSES (G) | ACC. LEAKED MASSES (G) |
|---|---|---|---|---|---|
| COND. WATER | 0.197463E-04 | 0.186218E+00 | 0.832188E-07 | 0.142173E+07 | |
| DRY PARTICLES | 0.776545E-05 | 0.369151E-02 | 0.107716E-05 | 0.559112E+06 | 0.194253E+03 |
| TOTAL | 0.275117E-04 | 0.189911E+00 | 0.116035E-05 | 0.198084E+07 | 0.194253E+03 |
| NUCL 1 | 0.388218E-06 | 0.184548E-03 | 0.538534E-07 | 0.279517E+05 | 0.971115E+01 |

PARTICLE CONC. = 8.99920E+05 (1/CM**3)    AV. RADIUS = 0.5823 (MICRONS)    AVERAGE DENSITY = 8.00 (G/CM**3)

LEAK RATE = 6.47711E-02 (G/SEC)    CONT. TEMP. = 130.0 (DEG C)    SATURATION RATIO = 1.00049
ACC.AER.SOURCE = 8.00308E+05 (G)

| K | PART.-RAD. (CM) | MASSDISTRIBUT. (G/CM**3) | NR.-DIST (1/CC) | SOLID MASS (G/CM**3) | H2O-MASS (G/CM**3) |
|---|---|---|---|---|---|
| 26 | 0.29730E-05 | 0.14611E-27 | 0.16590E-12 | 0.14611E-27 | 0.0 |
| 27 | 0.32826E-05 | 0.84901E-25 | 0.71620E-10 | 0.84901E-25 | 0.0 |
| 28 | 0.36243E-05 | 0.23809E-22 | 0.14922E-07 | 0.23809E-22 | 0.0 |
| 29 | 0.40016E-05 | 0.26074E-20 | 0.12142E-05 | 0.26074E-20 | 0.0 |
| 30 | 0.44182E-05 | 0.15745E-18 | 0.54472E-04 | 0.15745E-18 | 0.0 |
| 31 | 0.48781E-05 | 0.55396E-17 | 0.14239E-02 | 0.55396E-17 | 0.0 |
| 32 | 0.53860E-05 | 0.12135E-15 | 0.23175E-01 | 0.12135E-15 | 0.0 |
| 33 | 0.59467E-05 | 0.17499E-14 | 0.24828E+00 | 0.17499E-14 | 0.0 |
| 34 | 0.65658E-05 | 0.17386E-13 | 0.18328E+01 | 0.17386E-13 | 0.0 |
| 35 | 0.72493E-05 | 0.12486E-12 | 0.97787E+01 | 0.12486E-12 | 0.0 |
| 36 | 0.80040E-05 | 0.67367E-12 | 0.39200E+02 | 0.67367E-12 | 0.0 |
| 37 | 0.88372E-05 | 0.28733E-11 | 0.12422E+03 | 0.28733E-11 | 0.0 |
| 38 | 0.97572E-05 | 0.98574E-11 | 0.31662E+03 | 0.98574E-11 | 0.0 |
| 39 | 0.10773E-04 | 0.29108E-10 | 0.69462E+03 | 0.29108E-10 | 0.0 |
| 40 | 0.11895E-04 | 0.75983E-10 | 0.13472E+04 | 0.75983E-10 | 0.0 |
| 41 | 0.13133E-04 | 0.18003E-09 | 0.23715E+04 | 0.18003E-09 | 0.0 |
| 42 | 0.14500E-04 | 0.39518E-09 | 0.38676E+04 | 0.39518E-09 | 0.0 |
| 43 | 0.16010E-04 | 0.81297E-09 | 0.59115E+04 | 0.81297E-09 | 0.0 |
| 44 | 0.17676E-04 | 0.15890E-08 | 0.85846E+04 | 0.15890E-08 | 0.0 |
| 45 | 0.19516E-04 | 0.29808E-08 | 0.11964E+05 | 0.29808E-08 | 0.0 |
| 46 | 0.21548E-04 | 0.53981E-08 | 0.16098E+05 | 0.53981E-08 | 0.0 |
| 47 | 0.23791E-04 | 0.95151E-08 | 0.21082E+05 | 0.95151E-08 | 0.0 |
| 48 | 0.26268E-04 | 0.16162E-07 | 0.26604E+05 | 0.16162E-07 | 0.0 |
| 49 | 0.29003E-04 | 0.26746E-07 | 0.32711E+05 | 0.26746E-07 | 0.0 |
| 50 | 0.32022E-04 | 0.43045E-07 | 0.39113E+05 | 0.43045E-07 | 0.0 |
| 51 | 0.35356E-04 | 0.67536E-07 | 0.45594E+05 | 0.67536E-07 | 0.0 |
| 52 | 0.39037E-04 | 0.10372E-06 | 0.52025E+05 | 0.10372E-06 | 0.0 |
| 53 | 0.43101E-04 | 0.15738E-06 | 0.58650E+05 | 0.15738E-06 | 0.0 |
| 54 | 0.47588E-04 | 0.23736E-06 | 0.65717E+05 | 0.23736E-06 | 0.0 |
| 55 | 0.52542E-04 | 0.35599E-06 | 0.73228E+05 | 0.35599E-06 | 0.0 |
| 56 | 0.58012E-04 | 0.52713E-06 | 0.80562E+05 | 0.52713E-06 | 0.0 |
| 57 | 0.64051E-04 | 0.74143E-06 | 0.84188E+05 | 0.74143E-06 | 0.0 |
| 58 | 0.70719E-04 | 0.96563E-06 | 0.81463E+05 | 0.96563E-06 | 0.0 |
| 59 | 0.78081E-04 | 0.11368E-05 | 0.71255E+05 | 0.11368E-05 | 0.0 |
| 60 | 0.86210E-04 | 0.11923E-05 | 0.55522E+05 | 0.11923E-05 | 0.0 |
| 61 | 0.95185E-04 | 0.13361E-05 | 0.46228E+05 | 0.13361E-05 | 0.0 |
| 62 | 0.10509E-03 | 0.36098E-06 | 0.92790E+04 | 0.36098E-06 | 0.0 |
| 63 | 0.11603E-03 | 0.64268E-07 | 0.12274E+04 | 0.64267E-07 | 0.0 |
| 64 | 0.12811E-03 | 0.76188E-08 | 0.10810E+03 | 0.76188E-08 | 0.0 |
| 65 | 0.14145E-03 | 0.11651E-08 | 0.20446E+02 | 0.10627E-08 | 0.10242E-09 |
| 66 | 0.15618E-03 | 0.11791E-08 | 0.18144E+02 | 0.10286E-08 | 0.15046E-09 |
| 67 | 0.17244E-03 | 0.25063E-08 | 0.31966E+02 | 0.21112E-08 | 0.39507E-09 |
| 68 | 0.19039E-03 | 0.55102E-08 | 0.60737E+02 | 0.43809E-08 | 0.11293E-08 |
| 69 | 0.21021E-03 | 0.10727E-07 | 0.11411E+03 | 0.74474E-08 | 0.32800E-08 |
| 70 | 0.23209E-03 | 0.16130E-07 | 0.16912E+03 | 0.88909E-08 | 0.72393E-08 |
| 71 | 0.25626E-03 | 0.17132E-07 | 0.14100E+03 | 0.88798E-08 | 0.82519E-08 |
| 72 | 0.28293E-03 | 0.15096E-07 | 0.10083E+03 | 0.69693E-08 | 0.81269E-08 |
| 73 | 0.31239E-03 | 0.17154E-07 | 0.10264E+03 | 0.55521E-08 | 0.11602E-07 |
| 74 | 0.34491E-03 | 0.30653E-07 | 0.14992E+03 | 0.74374E-08 | 0.23215E-07 |
| 75 | 0.38082E-03 | 0.48413E-07 | 0.18144E+03 | 0.10396E-07 | 0.38017E-07 |
| 76 | 0.42046E-03 | 0.59842E-07 | 0.17141E+03 | 0.11276E-07 | 0.48566E-07 |

| | | | | | |
|---|---|---|---|---|---|
| 77 | 0.46423E-03 | 0.73582E-07 | 0.16498E+03 | 0.10144E-07 | 0.63438E-07 |
| 78 | 0.51256E-03 | 0.11110E-06 | 0.19272E+03 | 0.10750E-07 | 0.10035E-06 |
| 79 | 0.56592E-03 | 0.16123E-06 | 0.21025E+03 | 0.13629E-07 | 0.14761E-06 |
| 80 | 0.62484E-03 | 0.18748E-06 | 0.18241E+03 | 0.15011E-07 | 0.17247E-06 |
| 81 | 0.68989E-03 | 0.18323E-06 | 0.13353E+03 | 0.13093E-07 | 0.17013E-06 |
| 82 | 0.76171E-03 | 0.19742E-06 | 0.10899E+03 | 0.10004E-07 | 0.18742E-06 |
| 83 | 0.84100E-03 | 0.32953E-06 | 0.13824E+03 | 0.85788E-08 | 0.32095E-06 |
| 84 | 0.92856E-03 | 0.69414E-06 | 0.21845E+03 | 0.10641E-07 | 0.68350E-06 |
| 85 | 0.10252E-02 | 0.12643E-05 | 0.29620E+03 | 0.16568E-07 | 0.12477E-05 |
| 86 | 0.11320E-02 | 0.17684E-05 | 0.30777E+03 | 0.23465E-07 | 0.17450E-05 |
| 87 | 0.12498E-02 | 0.19706E-05 | 0.25471E+03 | 0.26959E-07 | 0.19436E-05 |
| 88 | 0.13799E-02 | 0.19271E-05 | 0.18508E+03 | 0.26171E-07 | 0.19009E-05 |
| 89 | 0.15236E-02 | 0.18163E-05 | 0.12966E+03 | 0.23778E-07 | 0.17925E-05 |
| 90 | 0.16822E-02 | 0.16951E-05 | 0.89931E+02 | 0.21584E-07 | 0.16735E-05 |
| 91 | 0.18573E-02 | 0.15479E-05 | 0.61016E+02 | 0.19634E-07 | 0.15282E-05 |
| 92 | 0.20507E-02 | 0.13694E-05 | 0.40101E+02 | 0.17555E-07 | 0.13518E-05 |
| 93 | 0.22641E-02 | 0.11719E-05 | 0.25493E+02 | 0.15230E-07 | 0.11567E-05 |
| 94 | 0.24998E-02 | 0.97187E-06 | 0.15705E+02 | 0.12780E-07 | 0.95909E-06 |
| 95 | 0.27601E-02 | 0.77881E-06 | 0.93495E+01 | 0.10335E-07 | 0.76847E-06 |
| 96 | 0.30474E-02 | 0.59836E-06 | 0.53364E+01 | 0.79944E-08 | 0.59036E-06 |
| 97 | 0.33647E-02 | 0.43582E-06 | 0.28877E+01 | 0.58523E-08 | 0.42997E-06 |
| 98 | 0.37150E-02 | 0.29682E-06 | 0.14611E+01 | 0.40007E-08 | 0.29282E-06 |
| 99 | 0.41017E-02 | 0.18600E-06 | 0.68024E+00 | 0.25140E-08 | 0.18349E-06 |
| 100 | 0.45287E-02 | 0.10522E-06 | 0.28590E+00 | 0.14251E-08 | 0.10380E-06 |
| 101 | 0.50000E-02 | 0.83547E-07 | 0.16870E+00 | 0.11175E-08 | 0.82430E-07 |

**********************************************************************************************************************************

TIME STEP # 5619 3.7021 SEC PROBLEM TIME 10474.62 SEC = 174.6 MIN = 2.9 HRS

| SPECIES | MASS CONCENTRATIONS (G/CM**3) | ACC. SEDI. DEPOSIT (G/CM**2) | ACC. DIFF. DEPOSIT (G/CM**2) | AIRBORNE MASSES (G) | ACC. LEAKED MASSES (G) |
|---|---|---|---|---|---|
| COND. WATER | 0.0 | 0.384859E+00 | 0.211236E-06 | 0.0 | |
| DRY PARTICLES | 0.287481E-05 | 0.139334E-01 | 0.160538E-05 | 0.206986E+06 | 0.350335E+03 |
| TOTAL | 0.287481E-05 | 0.398736E+00 | 0.181662E-05 | 0.206986E+06 | 0.350335E+03 |
| NUCL 1 | 0.994523E-07 | 0.660458E-03 | 0.778268E-07 | 0.716056E+04 | 0.170910E+02 |

PARTICLE CONC. = 4.71477E+06 (1/CM**3) AV. RADIUS = 0.2087 (MICRONS) AVERAGE DENSITY = 4.77 (G/CM**3)

LEAK RATE = 2.39682E-02 (G/SEC) CONT. TEMP. = 130.0 (DEG C) SATURATION RATIO = 0.96591
ACC.AER.SOURCE = 1.11139E+06 (G)

************************************************************************************************************************************

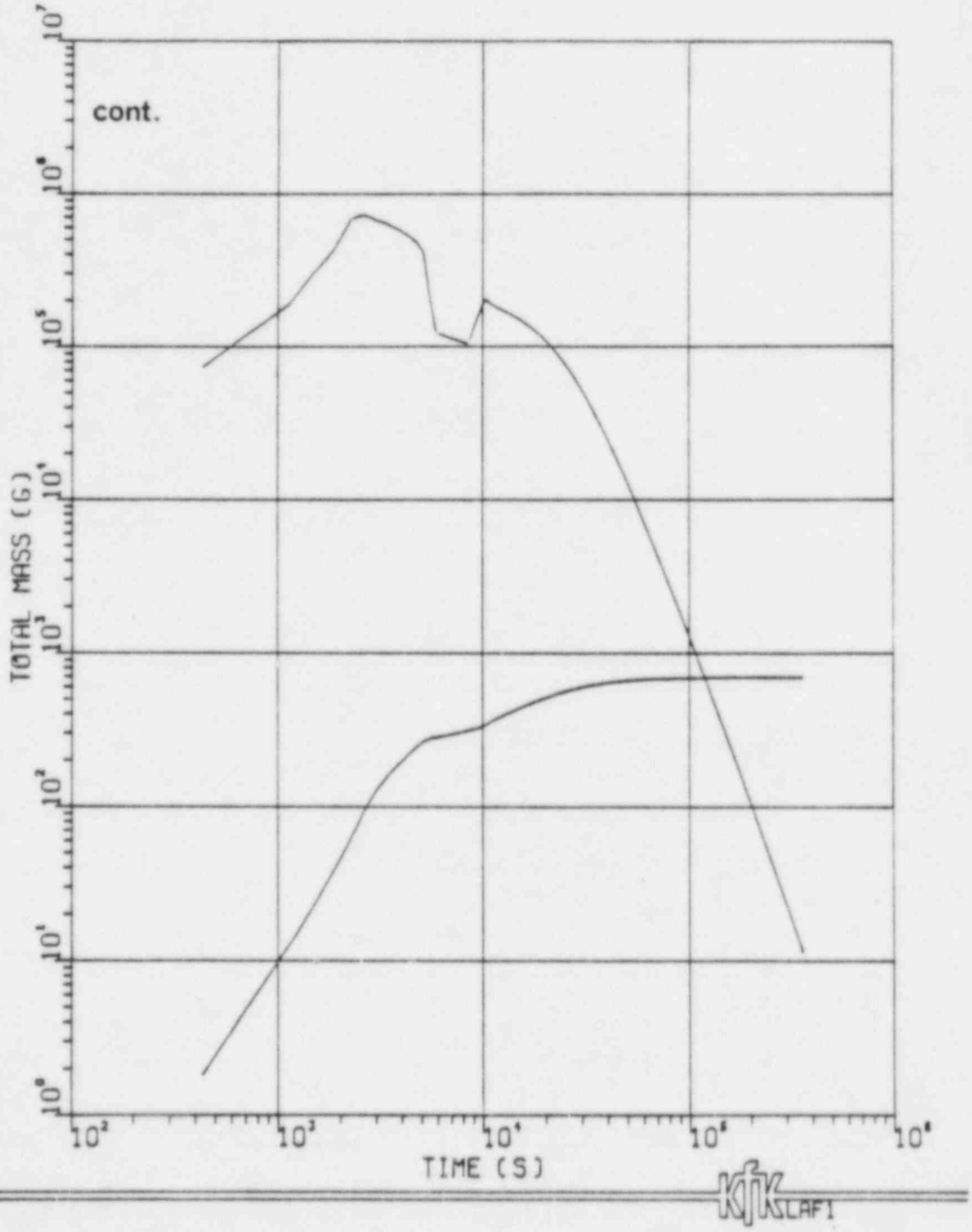
TIME STEP # 8533 858.2080 SEC PROBLEM TIME 360538.19 SEC = 6009.0 MIN = 100.1 HRS

| SPECIES | MASS CONCENTRATIONS (G/CM**3) | ACC. SEDI. DEPOSIT (G/CM**2) | ACC. DIFF. DEPOSIT (G/CM**2) | AIRBORNE MASSES (G) | ACC. LEAKED MASSES (G) |
|---|---|---|---|---|---|
| COND. WATER | 0.0 | 0.384859E+00 | 0.211236E-06 | 0.0 | |
| DRY PARTICLES | 0.155147E-09 | 0.171170E-01 | 0.256354E-05 | 0.111706E+02 | 0.697268E+03 |
| TOTAL | 0.155147E-09 | 0.401845E+00 | 0.277478E-05 | 0.111706E+02 | 0.697268E+03 |
| NUCL 1 | 0.536721E-11 | 0.770444E-03 | 0.110937E-06 | 0.386439E+00 | 0.290827E+02 |

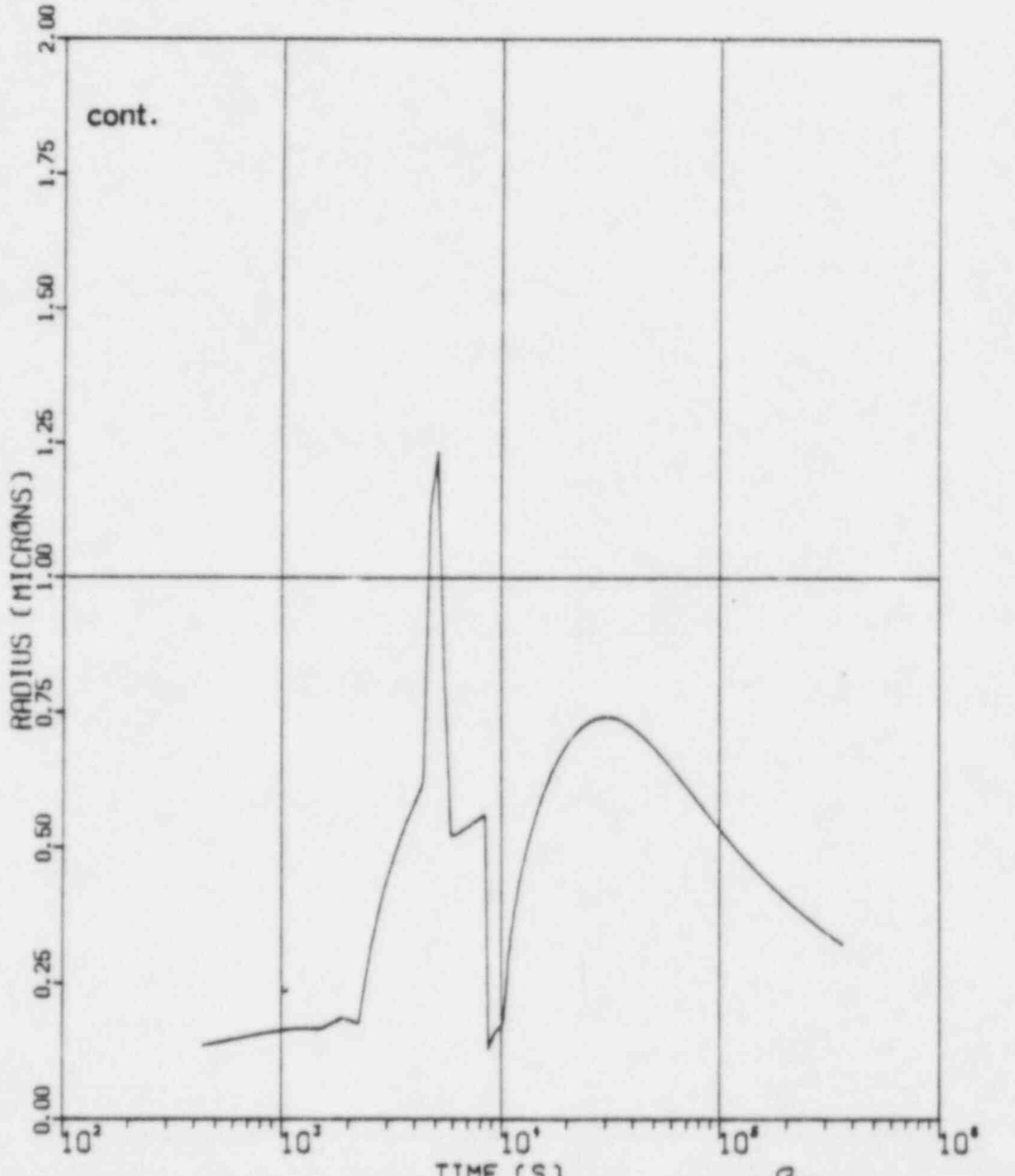
PARTICLE CONC. = 1.83638E+02 (1/CM**3) AV. RADIUS = 0.3229 (MICRONS) AVERAGE DENSITY = 4.77 (G/CM**3)

LEAK RATE = 1.30524E-06 (G/SEC) CONT. TEMP. = 130.0 (DEG C) SATURATION RATIO = 0.96591
ACC.AER.SOURCE = 1.11139E+06 (G)

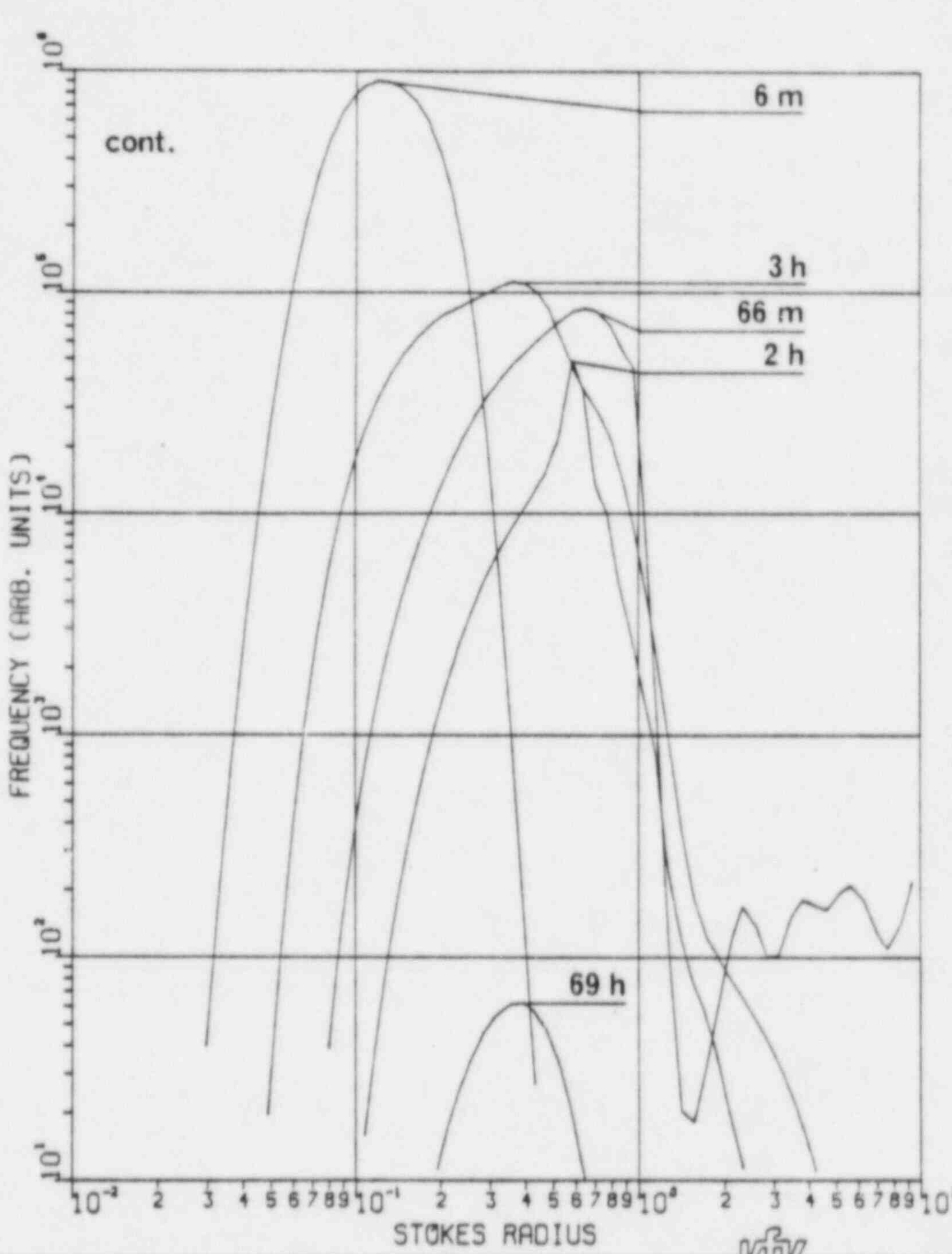
| K | PART.-RAD. (CM) | MASSDISTRIBUT. (G/CM**3) | NR.-DIST (1/CC) | SOLID MASS (G/CM**3) | H2O-MASS (G/CM**3) |
|---|---|---|---|---|---|
| 31 | 0.48781E-05 | 0.33624E-27 | 0.14529E-12 | 0.33624E-27 | 0.0 |
| 32 | 0.53860E-05 | 0.10674E-24 | 0.34285E-10 | 0.10674E-24 | 0.0 |
| 33 | 0.59467E-05 | 0.14771E-22 | 0.35199E-08 | 0.14771E-22 | 0.0 |
| 34 | 0.65658E-05 | 0.99996E-21 | 0.17703E-06 | 0.99996E-21 | 0.0 |
| 35 | 0.72493E-05 | 0.36567E-19 | 0.48130E-05 | 0.36567E-19 | 0.0 |
| 36 | 0.80040E-05 | 0.78867E-18 | 0.77092E-04 | 0.78867E-18 | 0.0 |
| 37 | 0.88372E-05 | 0.10839E-16 | 0.78704E-03 | 0.10839E-16 | 0.0 |
| 38 | 0.97572E-05 | 0.10197E-15 | 0.55126E-02 | 0.10197E-15 | 0.0 |
| 39 | 0.10773E-04 | 0.70447E-15 | 0.28277E-01 | 0.70447E-15 | 0.0 |
| 40 | 0.11895E-04 | 0.37651E-14 | 0.11226E+00 | 0.37651E-14 | 0.0 |
| 41 | 0.13133E-04 | 0.16229E-13 | 0.35942E+00 | 0.16229E-13 | 0.0 |
| 42 | 0.14500E-04 | 0.58158E-13 | 0.95672E+00 | 0.58158E-13 | 0.0 |
| 43 | 0.16010E-04 | 0.17733E-12 | 0.21672E+01 | 0.17733E-12 | 0.0 |
| 44 | 0.17676E-04 | 0.46826E-12 | 0.42514E+01 | 0.46826E-12 | 0.0 |
| 45 | 0.19516E-04 | 0.10869E-11 | 0.73306E+01 | 0.10869E-11 | 0.0 |
| 46 | 0.21548E-04 | 0.22482E-11 | 0.11267E+02 | 0.22482E-11 | 0.0 |
| 47 | 0.23791E-04 | 0.41959E-11 | 0.15621E+02 | 0.41959E-11 | 0.0 |
| 48 | 0.26268E-04 | 0.71483E-11 | 0.19790E+02 | 0.71483E-11 | 0.0 |
| 49 | 0.29003E-04 | 0.11178E-10 | 0.22985E+02 | 0.11178E-10 | 0.0 |
| 50 | 0.32022E-04 | 0.15986E-10 | 0.24419E+02 | 0.15986E-10 | 0.0 |
| 51 | 0.35356E-04 | 0.20624E-10 | 0.23401E+02 | 0.20624E-10 | 0.0 |
| 52 | 0.39037E-04 | 0.23546E-10 | 0.19847E+02 | 0.23546E-10 | 0.0 |
| 53 | 0.43101E-04 | 0.23309E-10 | 0.14596E+02 | 0.23309E-10 | 0.0 |
| 54 | 0.47588E-04 | 0.19568E-10 | 0.91029E+01 | 0.19568E-10 | 0.0 |
| 55 | 0.52542E-04 | 0.13561E-10 | 0.46870E+01 | 0.13561E-10 | 0.0 |
| 56 | 0.58012E-04 | 0.75246E-11 | 0.19321E+01 | 0.75246E-11 | 0.0 |
| 57 | 0.64051E-04 | 0.32159E-11 | 0.61374E+00 | 0.32159E-11 | 0.0 |
| 58 | 0.70719E-04 | 0.99466E-12 | 0.14103E+00 | 0.99466E-12 | 0.0 |
| 59 | 0.78081E-04 | 0.20697E-12 | 0.21802E-01 | 0.20697E-12 | 0.0 |
| 60 | 0.86210E-04 | 0.26460E-13 | 0.20707E-02 | 0.26460E-13 | 0.0 |
| 61 | 0.95185E-04 | 0.18668E-14 | 0.10854E-03 | 0.18668E-14 | 0.0 |
| 62 | 0.10509E-03 | 0.64345E-16 | 0.27792E-05 | 0.64345E-16 | 0.0 |
| 63 | 0.11603E-03 | 0.95354E-18 | 0.30598E-07 | 0.95354E-18 | 0.0 |
| 64 | 0.12811E-03 | 0.54565E-20 | 0.13008E-09 | 0.54565E-20 | 0.0 |
| 65 | 0.14145E-03 | 0.11645E-22 | 0.20626E-12 | 0.11645E-22 | 0.0 |




AIRBORNE AND ACC. LEAKED MASSES




AVERAGE PARTICLE RADIUS




PARTICLE SIZE DISTRIBUTIONS

NAUA - MOD4 INPUT DATA LISTING
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TEXT : NAUA SAMPLE CASE # 2 ------------------------------------------------
ANNULAR GAP, AEROSOL SOURCE = LEAK OF CONTAINMENT, NO STEAM, GRAVK

| | | |
|---|---|---|
| CONTROL VOLUME PARAMETERS | VOL | : 0.14675E+11 |
| | FSED | : 0.25640E+08 |
| | FDIFF | : 0.23624E+09 |
| AEROSOL PROCESS PARAMETERS | FORM | : 0.10000E+01 |
| | FORMC | : 0.10000E+01 |
| | FORMKO | : 0.10000E+01 |
| | DELD | : 0.10000E-01 |
| NUMERICAL PARAMETERS | RMIN | : 0.25000E-06 |
| | RMAX | : 0.50000E-02 |
| | KMAX | : 101 |
| | EPS | : 0.10000E+00 |
| | CUTOFF | : 0.10000E-14 |
| PROGRAM CONTROL PARAMETERS | SZEIT | : 0.0 |
| | TIME | : 100.00 |
| | CPUZT | : 120.00 |
| | RESTRT | : F |
| | ZWCOMP | : T |
| | FOLGE | : F |
| | GRAVK | : T |
| | LEAK | : T |
| | LKOND | : F |
| | TIMEK1 | : 0.0 |
| | TIMEK2 | : 0.0 |
| | TIMEK3 | : 0.0 |
| | TIMEK4 | : 0.0 |
| OUTPUT CONTROL PARAMETERS | NWRITE | : 10 |
| | | : 100 |
| | NPLOT | : 5 |

```
AEROSOL SOURCE FUNCTIONS CONTAINING  1 RELEASES AND  1 NUCLIDES
UP TO       0.0 SEC
MODE1  0.0          (G)     RG  1.00000E+00 SIGL  1.00000E+00 RHO  1.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      0.0
MODE2  0.0          (G)     RG  1.00000E+00 SIGL  1.00000E+00 RHO  1.000
CONTAINING THE FOLLOWING NUCLIDE FRACTIONS
NUCL 1      0.0
CONTAINMENTTEMPERATURE IN TIMESTEPS OF       1 SEC UP TO       0 SEC
  130.00
STEAMFLOW INTO THE CONTAINMENT AT   1 GRID POINTS

  TIME (SEC)   RATE (G/SEC)

 0.0           0.0
LEAKRATE OUT OF THE CONTAINMENT AT    1 GRID POINTS

  TIME (SEC)   RATE (1/SEC)

 0.0           0.50000E-06
****************************************************************************************************************
SUBSEQUENT COMPARTMENT
PRECEDING VOLUME  7.200001E+10 (CM**3), DILUTION FACTOR  4.906 WITH THE   1 FOLLOWING NUCLIDES
NUCL 1
****************************************************************************************************************
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TIME STEP # 100 20.0000 SEC PROBLEM TIME 2000.00 SEC = 33.3 MIN = 0.6 HRS

| SPECIES | MASS CONCENTRATIONS (G/CM**3) | ACC. SEDI. DEPOSIT (G/CM**2) | ACC. DIFF. DEPOSIT (G/CM**2) | AIRBORNE MASSES (G) | ACC. LEAKED MASSES (G) |
|---|---|---|---|---|---|
| COND. WATER | 0.0 | 0.0 | 0.0 | 0.0 | |
| DRY PARTICLES | 0.308400E-08 | 0.220733E-07 | 0.177141E-09 | 0.452577E+02 | 0.140194E-01 |
| TOTAL | 0.308400E-08 | 0.220733E-07 | 0.177141E-09 | 0.452577E+02 | 0.140194E-01 |
| NUCL 1 | 0.154180E-09 | 0.110354E-08 | 0.885616E-11 | 0.226259E+01 | 0.700898E-03 |

PARTICLE CONC. = 1.05776E+04 (1/CM**3) AV. RADIUS = 0.1572 (MICRONS) AVERAGE DENSITY = 8.00 (G/CM**3)

LEAK RATE = 2.26427E-05 (G/SEC) CONT. TEMP. = 130.0 (DEG C) SATURATION RATIO = 1.00100
ACC.AER.SOURCE = 0.0 (G)

| K | PART.-RAD. (CM) | MASSDISTRIBUT. (G/CM**3) | NR.-DIST (1/CC) | SOLID MASS (G/CM**3) | H2O-MASS (G/CM**3) |
|---|---|---|---|---|---|
| 14 | 0.90589E-06 | 0.12992E-29 | 0.52153E-13 | 0.12992E-29 | 0.0 |
| 15 | 0.10002E-05 | 0.34434E-28 | 0.10270E-11 | 0.34434E-28 | 0.0 |
| 16 | 0.11043E-05 | 0.80378E-27 | 0.17811E-10 | 0.80378E-27 | 0.0 |
| 17 | 0.12193E-05 | 0.16544E-25 | 0.27237E-09 | 0.16544E-25 | 0.0 |
| 18 | 0.13462E-05 | 0.30056E-24 | 0.36764E-08 | 0.30056E-24 | 0.0 |
| 19 | 0.14864E-05 | 0.48233E-23 | 0.43833E-07 | 0.48233E-23 | 0.0 |
| 20 | 0.16411E-05 | 0.68388E-22 | 0.46177E-06 | 0.68388E-22 | 0.0 |
| 21 | 0.18120E-05 | 0.85718E-21 | 0.43001E-05 | 0.85718E-21 | 0.0 |
| 22 | 0.20006E-05 | 0.94977E-20 | 0.35399E-04 | 0.94977E-20 | 0.0 |
| 23 | 0.22089E-05 | 0.93047E-19 | 0.25766E-03 | 0.93047E-19 | 0.0 |
| 24 | 0.24388E-05 | 0.80587E-18 | 0.16579E-02 | 0.80587E-18 | 0.0 |
| 25 | 0.26927E-05 | 0.61699E-17 | 0.94306E-02 | 0.61699E-17 | 0.0 |
| 26 | 0.29730E-05 | 0.41745E-16 | 0.47407E-01 | 0.41745E-16 | 0.0 |
| 27 | 0.32826E-05 | 0.24961E-15 | 0.21060E+00 | 0.24961E-15 | 0.0 |
| 28 | 0.36243E-05 | 0.13189E-14 | 0.82677E+00 | 0.13189E-14 | 0.0 |
| 29 | 0.40016E-05 | 0.61529E-14 | 0.28658E+01 | 0.61529E-14 | 0.0 |
| 30 | 0.44182E-05 | 0.25356E-13 | 0.87741E+01 | 0.25356E-13 | 0.0 |
| 31 | 0.48781E-05 | 0.92295E-13 | 0.23728E+02 | 0.92295E-13 | 0.0 |
| 32 | 0.53860E-05 | 0.29658E-12 | 0.56649E+02 | 0.29658E-12 | 0.0 |
| 33 | 0.59467E-05 | 0.84211E-12 | 0.11951E+03 | 0.84211E-12 | 0.0 |
| 34 | 0.65658E-05 | 0.21135E-11 | 0.22284E+03 | 0.21135E-11 | 0.0 |
| 35 | 0.72493E-05 | 0.46998E-11 | 0.36816E+03 | 0.46998E-11 | 0.0 |
| 36 | 0.80040E-05 | 0.93014E-11 | 0.54134E+03 | 0.93014E-11 | 0.0 |
| 37 | 0.88372E-05 | 0.16508E-10 | 0.71383E+03 | 0.16508E-10 | 0.0 |
| 38 | 0.97572E-05 | 0.26556E-10 | 0.85319E+03 | 0.26556E-10 | 0.0 |
| 39 | 0.10773E-04 | 0.39225E-10 | 0.93628E+03 | 0.39225E-10 | 0.0 |
| 40 | 0.11895E-04 | 0.53888E-10 | 0.95564E+03 | 0.53888E-10 | 0.0 |
| 41 | 0.13133E-04 | 0.69680E-10 | 0.91806E+03 | 0.69680E-10 | 0.0 |
| 42 | 0.14500E-04 | 0.85747E-10 | 0.83936E+03 | 0.85747E-10 | 0.0 |
| 43 | 0.16010E-04 | 0.10152E-09 | 0.73833E+03 | 0.10152E-09 | 0.0 |
| 44 | 0.17676E-04 | 0.11691E-09 | 0.63172E+03 | 0.11691E-09 | 0.0 |
| 45 | 0.19516E-04 | 0.13233E-09 | 0.53125E+03 | 0.13233E-09 | 0.0 |
| 46 | 0.21548E-04 | 0.14852E-09 | 0.44299E+03 | 0.14852E-09 | 0.0 |
| 47 | 0.23791E-04 | 0.16623E-09 | 0.36837E+03 | 0.16623E-09 | 0.0 |
| 48 | 0.26268E-04 | 0.18582E-09 | 0.30596E+03 | 0.18582E-09 | 0.0 |
| 49 | 0.29003E-04 | 0.20707E-09 | 0.25331E+03 | 0.20707E-09 | 0.0 |
| 50 | 0.32022E-04 | 0.22875E-09 | 0.20790E+03 | 0.22875E-09 | 0.0 |
| 51 | 0.35356E-04 | 0.24817E-09 | 0.16757E+03 | 0.24817E-09 | 0.0 |
| 52 | 0.39037E-04 | 0.26047E-09 | 0.13067E+03 | 0.26047E-09 | 0.0 |
| 53 | 0.43101E-04 | 0.25925E-09 | 0.96628E+02 | 0.25925E-09 | 0.0 |
| 54 | 0.47588E-04 | 0.23892E-09 | 0.66163E+02 | 0.23892E-09 | 0.0 |
| 55 | 0.52542E-04 | 0.20091E-09 | 0.41336E+02 | 0.20091E-09 | 0.0 |
| 56 | 0.58012E-04 | 0.14878E-09 | 0.22743E+02 | 0.14878E-09 | 0.0 |
| 57 | 0.64051E-04 | 0.64704E-10 | 0.73487E+01 | 0.64704E-10 | 0.0 |
| 58 | 0.70719E-04 | 0.27904E-10 | 0.23545E+01 | 0.27904E-10 | 0.0 |
| 59 | 0.78081E-04 | 0.13636E-10 | 0.85484E+00 | 0.13636E-10 | 0.0 |
| 60 | 0.86210E-04 | 0.82569E-11 | 0.38458E+00 | 0.82569E-11 | 0.0 |
| 61 | 0.95185E-04 | 0.62760E-11 | 0.21718E+00 | 0.62760E-11 | 0.0 |
| 62 | 0.10509E-03 | 0.45055E-11 | 0.11584E+00 | 0.45055E-11 | 0.0 |
| 63 | 0.11603E-03 | 0.28581E-11 | 0.54595E-01 | 0.28581E-11 | 0.0 |
| 64 | 0.12811E-03 | 0.16700E-11 | 0.23700E-01 | 0.16700E-11 | 0.0 |

| | | | | | |
|---|---|---|---|---|---|
| 65 | 0.14145E-03 | 0.88277E-12 | 0.93079E-02 | 0.88277E-12 | 0.0 |
| 66 | 0.15618E-03 | 0.43990E-12 | 0.34461E-02 | 0.43990E-12 | 0.0 |
| 67 | 0.17244E-03 | 0.16052E-12 | 0.93428E-03 | 0.16052E-12 | 0.0 |
| 68 | 0.19039E-03 | 0.50983E-13 | 0.22046E-03 | 0.50983E-13 | 0.0 |
| 69 | 0.21021E-03 | 0.16419E-13 | 0.52751E-04 | 0.16419E-13 | 0.0 |
| 70 | 0.23209E-03 | 0.41529E-14 | 0.99128E-05 | 0.41529E-14 | 0.0 |
| 71 | 0.25626E-03 | 0.87758E-15 | 0.15563E-05 | 0.87758E-15 | 0.0 |
| 72 | 0.28293E-03 | 0.15210E-15 | 0.20040E-06 | 0.15210E-15 | 0.0 |
| 73 | 0.31239E-03 | 0.18907E-16 | 0.18509E-07 | 0.18907E-16 | 0.0 |
| 74 | 0.34491E-03 | 0.22913E-17 | 0.16665E-08 | 0.22913E-17 | 0.0 |
| 75 | 0.38082E-03 | 0.33407E-18 | 0.18052E-09 | 0.33407E-18 | 0.0 |
| 76 | 0.42046E-03 | 0.30812E-19 | 0.12370E-10 | 0.30812E-19 | 0.0 |
| 77 | 0.46423E-03 | 0.21409E-20 | 0.63858E-12 | 0.21409E-20 | 0.0 |
| 78 | 0.51256E-03 | 0.12805E-21 | 0.28378E-13 | 0.12805E-21 | 0.0 |

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TIME STEP # 4009          9.2335 SEC          PROBLEM TIME   16435.65 SEC =   273.9 MIN =   4.6 HRS

| SPECIES | MASS CONCENTRATIONS (G/CM**3) | ACC. SEDI. DEPOSIT (G/CM**2) | ACC. DIFF. DEPOSIT (G/CM**2) | AIRBORNE MASSES (G) | ACC. LEAKED MASSES (G) |
|---|---|---|---|---|---|
| COND. WATER | 0.0 | 0.0 | 0.0 | 0.0 | |
| DRY PARTICLES | 0.153803E-07 | 0.909837E-05 | 0.930041E-08 | 0.225705E+03 | 0.147005E+01 |
| TOTAL | 0.153803E-07 | 0.909837E-05 | 0.930041E-08 | 0.225705E+03 | 0.147005E+01 |
| NUCL 1 | 0.655249E-09 | 0.435647E-06 | 0.443278E-09 | 0.961578E+01 | 0.699808E-01 |

PARTICLE CONC. = 2.01572E+04 (1/CM**3)   AV. RADIUS = 0.2058 (MICRONS)   AVERAGE DENSITY = 6.04 (G/CM**3)

LEAK RATE = 1.12926E-04 (G/SEC)   CONT. TEMP. = 130.0 (DEG C)   SATURATION RATIO = 1.00160

ACC.AER.SOURCE = 0.0 (G)

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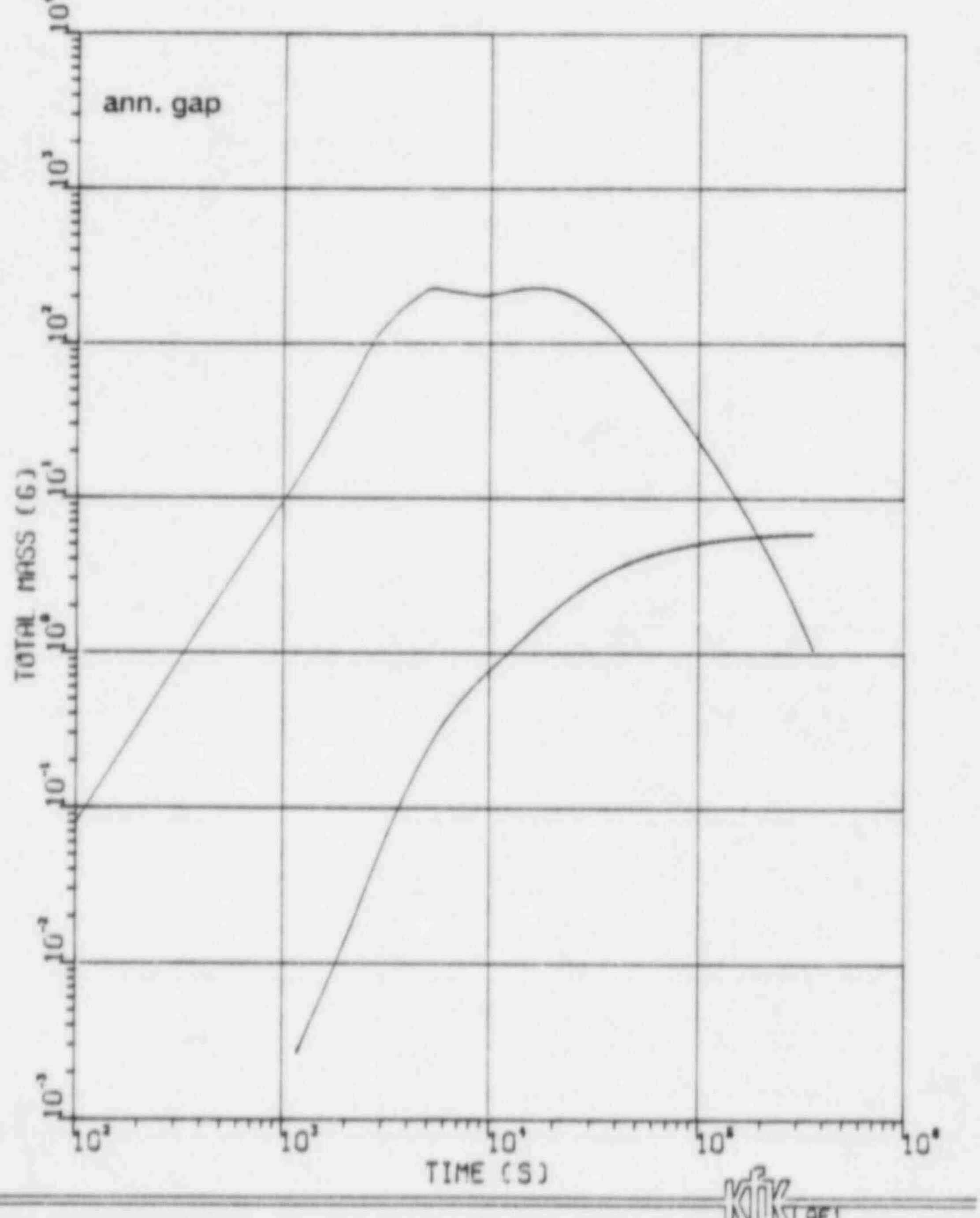
TIME STEP # 7248 431.7363 SEC PROBLEM TIME 360025.50 SEC = 6000.4 MIN = 100.0 HRS

| SPECIES | MASS CONCENTRATIONS (G/CM**3) | ACC. SEDI. DEPOSIT (G/CM**2) | ACC. DIFF. DEPOSIT (G/CM**2) | AIRBORNE MASSES (G) | ACC. LEAKED MASSES (G) |
|---|---|---|---|---|---|
| COND. WATER | 0.0 | 0.0 | 0.0 | 0.0 | |
| DRY PARTICLES | 0.723041E-10 | 0.264993E-04 | 0.409116E-07 | 0.106106E+01 | 0.591703E+01 |
| TOTAL | 0.723041E-10 | 0.264993E-04 | 0.409116E-07 | 0.106106E+01 | 0.591703E+01 |
| NUCL 1 | 0.255599E-11 | 0.110626E-05 | 0.162741E-08 | 0.375092E-01 | 0.238259E+00 |

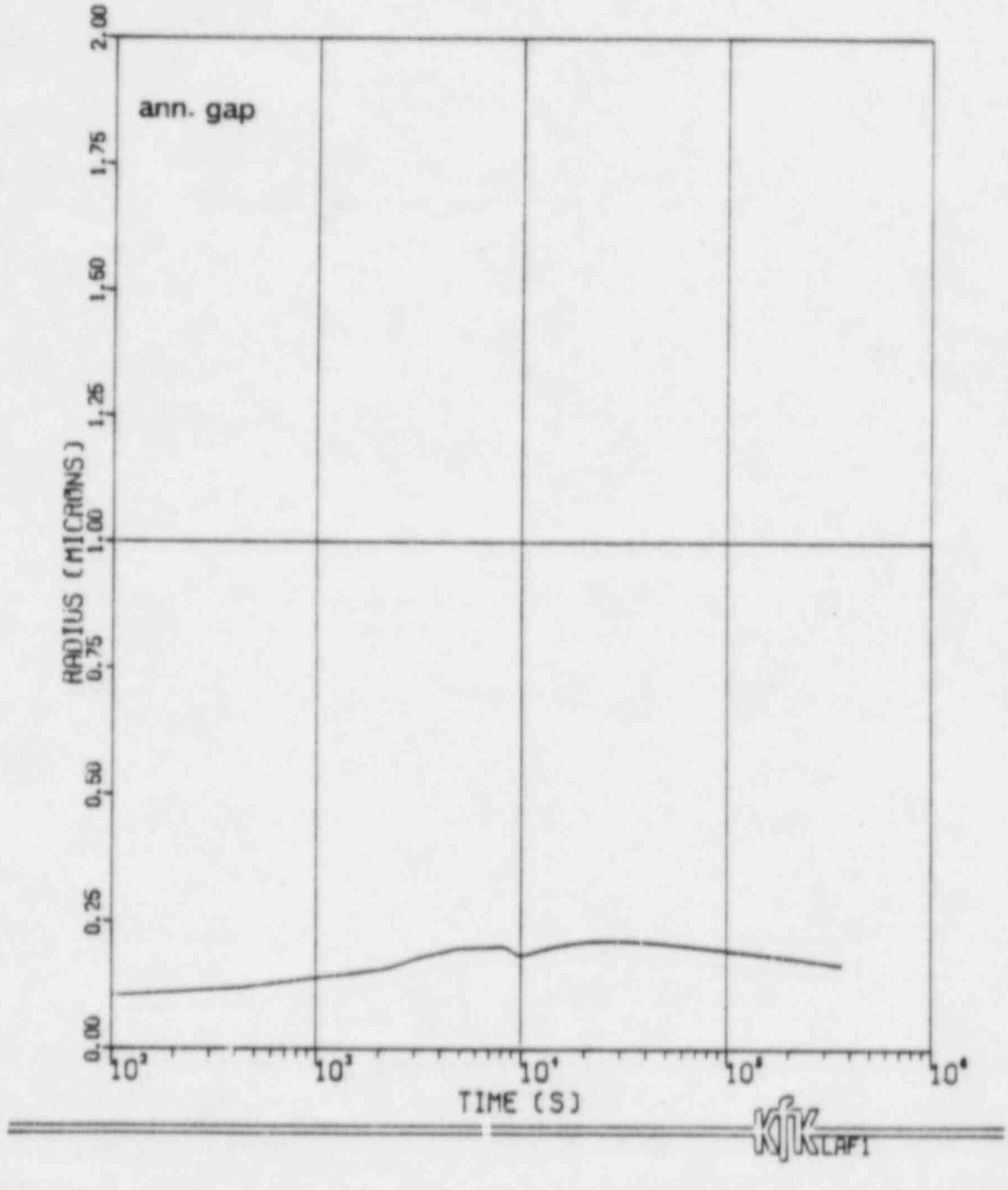
PARTICLE CONC. = 5.45758E+02 (1/CM**3) AV. RADIUS = 0.1662 (MICRONS) AVERAGE DENSITY = 4.87 (G/CM**3)

LEAK RATE = 5.32867E-07 (G/SEC) CONT. TEMP. = 130.0 (DEG C) SATURATION RATIO = 1.00100
ACC.AER.SOURCE = 0.0 (G)

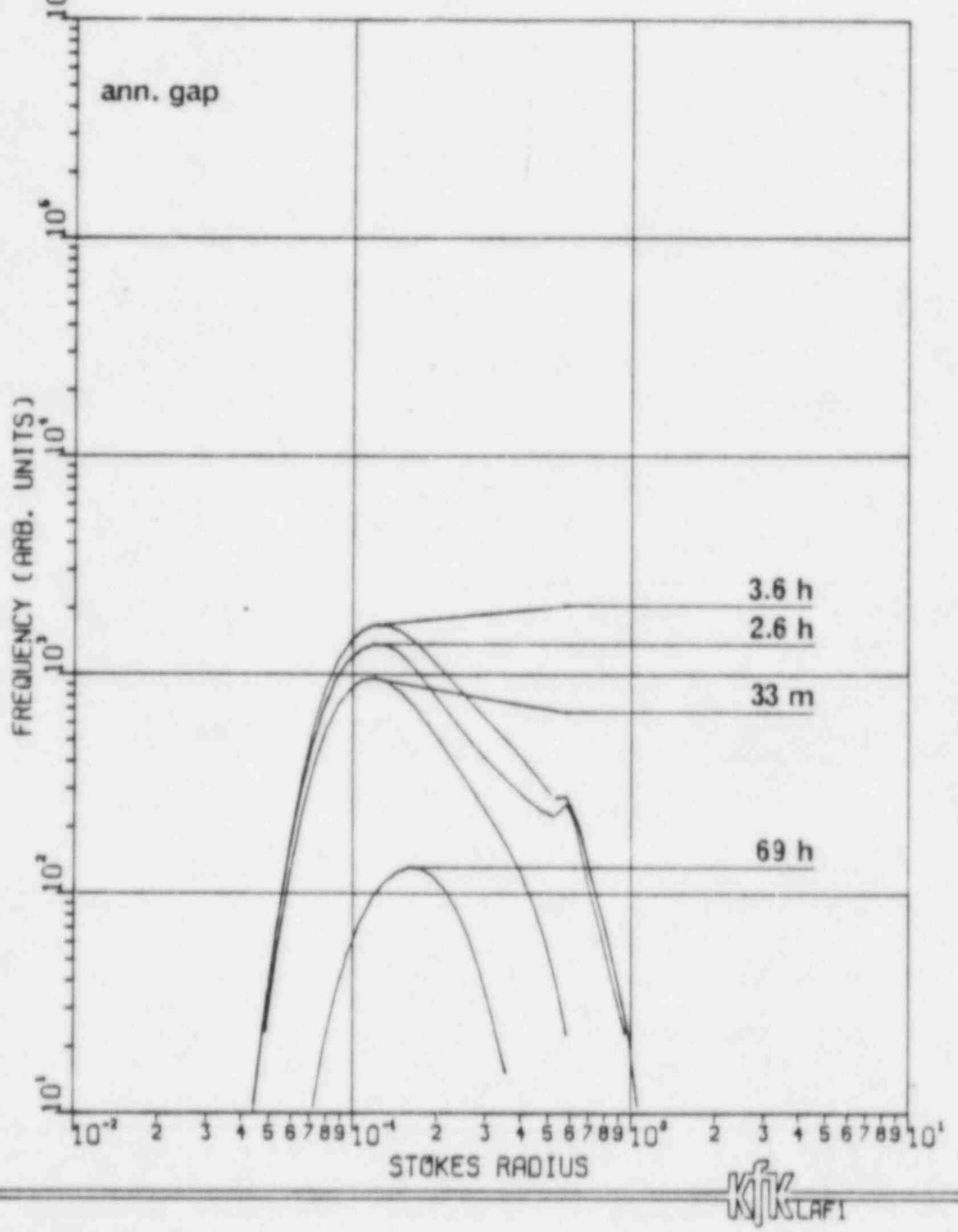
| K | PART.-RAD. (CM) | MASSDISTRIBUT. (G/CM**3) | NR.-DIST (1/CC) | SOLID MASS (G/CM**3) | H2O-MASS (G/CM**3) |
|---|---|---|---|---|---|
| 23 | 0.22089E-05 | 0.75157E-29 | 0.34294E-13 | 0.75157E-29 | 0.0 |
| 24 | 0.24388E-05 | 0.19371E-26 | 0.65675E-11 | 0.19371E-26 | 0.0 |
| 25 | 0.26927E-05 | 0.25123E-24 | 0.63223E-09 | 0.25123E-24 | 0.0 |
| 26 | 0.29730E-05 | 0.18072E-22 | 0.33780E-07 | 0.18072E-22 | 0.0 |
| 27 | 0.32826E-05 | 0.77769E-21 | 0.10803E-05 | 0.77769E-21 | 0.0 |
| 28 | 0.36243E-05 | 0.21447E-19 | 0.22119E-04 | 0.21447E-19 | 0.0 |
| 29 | 0.40016E-05 | 0.39763E-18 | 0.30615E-03 | 0.39763E-18 | 0.0 |
| 30 | 0.44182E-05 | 0.52322E-17 | 0.29902E-02 | 0.52322E-17 | 0.0 |
| 31 | 0.48781E-05 | 0.50273E-16 | 0.21314E-01 | 0.50273E-16 | 0.0 |
| 32 | 0.53860E-05 | 0.36483E-15 | 0.11484E+00 | 0.36483E-15 | 0.0 |
| 33 | 0.59467E-05 | 0.20437E-14 | 0.47785E+00 | 0.20437E-14 | 0.0 |
| 34 | 0.65658E-05 | 0.90097E-14 | 0.15637E+01 | 0.90097E-14 | 0.0 |
| 35 | 0.72493E-05 | 0.32044E-13 | 0.41293E+01 | 0.32044E-13 | 0.0 |
| 36 | 0.80040E-05 | 0.93524E-13 | 0.89686E+01 | 0.93524E-13 | 0.0 |
| 37 | 0.88372E-05 | 0.22998E-12 | 0.16371E+02 | 0.22998E-12 | 0.0 |
| 38 | 0.97572E-05 | 0.48807E-12 | 0.25895E+02 | 0.48807E-12 | 0.0 |
| 39 | 0.10773E-04 | 0.92398E-12 | 0.36367E+02 | 0.92398E-12 | 0.0 |
| 40 | 0.11895E-04 | 0.15918E-11 | 0.46507E+02 | 0.15918E-11 | 0.0 |
| 41 | 0.13133E-04 | 0.25313E-11 | 0.54968E+02 | 0.25313E-11 | 0.0 |
| 42 | 0.14500E-04 | 0.37418E-11 | 0.60409E+02 | 0.37418E-11 | 0.0 |
| 43 | 0.16010E-04 | 0.51506E-11 | 0.61782E+02 | 0.51506E-11 | 0.0 |
| 44 | 0.17676E-04 | 0.65844E-11 | 0.58665E+02 | 0.65844E-11 | 0.0 |
| 45 | 0.19516E-04 | 0.77792E-11 | 0.51483E+02 | 0.77792E-11 | 0.0 |
| 46 | 0.21548E-04 | 0.84395E-11 | 0.41485E+02 | 0.84395E-11 | 0.0 |
| 47 | 0.23791E-04 | 0.83478E-11 | 0.30477E+02 | 0.83477E-11 | 0.0 |
| 48 | 0.26268E-04 | 0.74927E-11 | 0.20337E+02 | 0.74927E-11 | 0.0 |
| 49 | 0.29003E-04 | 0.60854E-11 | 0.12270E+02 | 0.60854E-11 | 0.0 |
| 50 | 0.32022E-04 | 0.45176E-11 | 0.67644E+01 | 0.45176E-11 | 0.0 |
| 51 | 0.35356E-04 | 0.31424E-11 | 0.34939E+01 | 0.31424E-11 | 0.0 |
| 52 | 0.39037E-04 | 0.21111E-11 | 0.17429E+01 | 0.21111E-11 | 0.0 |
| 53 | 0.43101E-04 | 0.13825E-11 | 0.84756E+00 | 0.13825E-11 | 0.0 |
| 54 | 0.47588E-04 | 0.85420E-12 | 0.38907E+00 | 0.85420E-12 | 0.0 |
| 55 | 0.52542E-04 | 0.46603E-12 | 0.15771E+00 | 0.46603E-12 | 0.0 |
| 56 | 0.58012E-04 | 0.21027E-12 | 0.52860E-01 | 0.21027E-12 | 0.0 |
| 57 | 0.64051E-04 | 0.74126E-13 | 0.13875E-01 | 0.74126E-13 | 0.0 |
| 58 | 0.70719E-04 | 0.18942E-13 | 0.26343E-02 | 0.18942E-13 | 0.0 |
| 59 | 0.78081E-04 | 0.32555E-14 | 0.33618E-03 | 0.32555E-14 | 0.0 |
| 60 | 0.86210E-04 | 0.34339E-15 | 0.26329E-04 | 0.34339E-15 | 0.0 |
| 61 | 0.95185E-04 | 0.19963E-16 | 0.11366E-05 | 0.19963E-16 | 0.0 |
| 62 | 0.10509E-03 | 0.56650E-18 | 0.23977E-07 | 0.56650E-18 | 0.0 |
| 63 | 0.11603E-03 | 0.68963E-20 | 0.21706E-09 | 0.68963E-20 | 0.0 |
| 64 | 0.12811E-03 | 0.32213E-22 | 0.75265E-12 | 0.32213E-22 | 0.0 |




AIRBØRNE AND ACC. LEAKED MASSES




AVERAGE PARTICLE RADIUS




PARTICLE SIZE DISTRIBUTIONS