# PANTHERE RP :A TOOL FOR PREVISION OF DOSE RATES

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## ABSTRACT:

Different tools can be used for the preparation of maintenance One of them is **PANTHERE RP** : it allows the prediction of dose rates .

## RESUME

Différents outils peuvent être utlisés pour la préparation de la maintenance . **PANTHERE RP** est l'un d'eux: il permet de prévoir les débits d'équivalent de dose .

## I INTRODUCTION

With the aim to maintain the fair dosimetric results of french nuclear power plants , tools allowing a better preparation of normal and exceptional maintenance are currently developped by EDF .Among these tools , one is "PANTHERE RP" that allows the detailed prediction of dose rates for complex geometries with distribued radioactive sources . These abilities are required to simulate the most frequently encountered situations in NPP .

## II COLLECTIVE DOSE (CD)

CD is defined ,for a given task, as follow : **CD = DR *WORK VOLUME**
man.Sv SV/unit time MAN.unit time

The simplicity of the formula should not hide the practical difficulties :
-a whole maintenance task is a sum of elementary subtasks ,
-a unique DR for a given subtask is indeed a crude approximation ,
-feeding sound values of DR and WV is not at all straightforward .

It may be useful to remind that DRs values , job organisation , actions to minimize/optimize DRs should not be considered as independant parameters .To optimize CD , it is of course necessary to minimize both factors DR et WV .Because of the scope of EDF SEPTEN Radiation Protection Group , we have focused on the **DR factor .**

## III PANTHERE RP

The name is an acronym for :" **Prediction and THeorical ANalysis of Exposition at REactors for Radiation Protection** "

The prediction of DRs when a given job will be performed can be obtained by various means :from existing experience (prope or foreign) and from direct measurement .In both cases , one is confronted to the same problem :Dose Rate is a global parameter : you still do not know where it comes from !Anyway , DR measurements cannot be performed in same situations .For example , you cannot measure the dose rate ine the axis of a primary pipe before you have cut it ....

It appears that the best solution is to simulate the dose rate via calculations : this is precisely the aim of PANTHERE RP .

### 3-1 where does PANTHERE RP come from ?

Softwares to calcultate the DR have been developped and used by EDF during the design

stage of nuclear units .

The shifting to the utilization for maintenance (preparation of jobs) has actually begun with the steam replacement at DAMPIERRE 1 .The importance of DR prevision in the overall process of doses prediction has led to further developpments of existing softwares .The resulting product is a linkage between numerous softwares , and has been named PANTHERE RP V0

PANTHERE RP V0 allows :
- to perform DR mapping for complex lay out ,(figures 1)
- to give , for any point where DR is calculated , the contribution of the various parts of the installation ,
-to precise the influence of source composition (isotopes/evolution with time).

### 3-2 PANTHERE RP AT WORK

PANTHERE RP allows the calculation of DR , starting from a 3 dimensional representation of the geometry and the knowledge of radioactive sources .This representation is more or less easily obtained wether you can extract it of a computerized mockup or not . In this last case , appropriate softwares of PANTHERE RP help the user to build up the geometry from charts : this construction is interactive .

The computering process can then be performed This step does not need an important participation of the user .The underlying idea has been that the user was not interested in the details of the calculation process ,but rather by the results !

These can be represented in different ways :tables (figure2),graphs ,graphic display .

The description of figure 2 shows the interest of DR calculation :

The geometry is organized in "lines" , each line is composed of elementary "sections": The lines are here hot leg (BC) , cross over leg (BU) and so on ..the total dose rate is split in participation from the lines (absolute and relative in per cent of total DR) .For each line we can see the relative participation of the most important sections (>0%) and the participation of the main isotopes (here the CO58 et the sum of CO58 and CO60 ("Co")).

With the diversity of the results representations ,one has ready at hand the right indications to propose protection actions such as :partial or total decontamination,suppression of this or that portion of pipe at the beginning of the job rather that at a later date ,additional shielding .

The effect of any of these proposed dispositions can be verified by calculation :this is achieved in the simplest manner ,i.e going back to the geometry input and modifying it consequently .

### 3-3 validation-qualification

A comparison of measured and calculated DR has been performed by the mean of special surveys, for example at DAMPIERRE 1 and FESSENHEIM 1.It has been shown that a good agreement was obtained .

In both cases , the sources were monitored directly by gamma spectrometry with the EMECC system: **a good knowledge of sources is very important to perform a good prediction .**

But in addition of gamma spectrometry ,PANTHERE RP allows the use of DR measurements : different hypothesis can be easily tested to simulate the repartition and strengh of sources .

## IV PERSPECTIVE NEXT FUTURE

PANTHERE RP is a powerfull tool that allows to cope with a large span of problems . This software is implemented on the EDF computer network so that the multipe shuffling informations (data base results ..) is not a problem .

We work to create a **PANTHERE RP version V1** for which the specifications are :

- equal or enhance PANTHERE RP V0 capacities ,
- be more user friendly
- available on work stations (and if possible a micro-computer)
- use near worksites .

## V OTHERS TOOLS CONNECTED WITH PANTHERE RP

We can distinguish the tools above et below PANTHERE RP .

### TOOLS UPSTREAM PANTHERE RP

It are used for the knowledge of sources .

We can cite :

- **PACTOLE** computer code (CEA/SCOS) for the prediction of corrosion products contamination (water and deposit) for the PWR's reactors ,

- **PROFIP** computer code (CEA/SCOS) for the transport of fission products from nuclear fuel ,

- **TRIPOLI** computer code (CEA/SERMA) for the prediction of the transport of gamma or neutrons ,

- **EMECC** (CEA/SCOS) a portable spectrogammameter for the measurements of the volumic or surface contamination for corrosion and fission products : it will be connected with diagnosis softwares for analysis of hot spots or on line survey of fuel cladding .

- **DATA BASE** on the EDF network ,as TIGRE RP from EDF,to manage and analyze the observations on reactors .

### TOOLS DOWNSTREAM PANTHERE RP

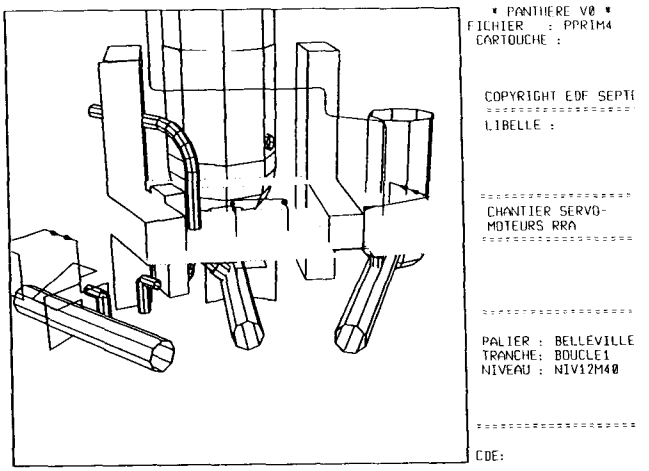
They are performed to the prediction of individual or collective doses . We can cite the**DOSIANA** code from CEPN/EDF/FRAMATOME , which uses measurements or calculated (with PANTHERE or other code) dose rates .

## VI CONCLUSION

PANTHERE RP allows the calculation of the dose rates We hope that it will be used ,in the future, near the worksites of maintenance to be included entirely in the largest process of the prediction of collective doses .

# FIGURES

## FIGURE 1




## FIGURE 2

DDD AU POINT : 1

TEMPS INITIAL : 0. j

PANTHERE
RP

| LIGNE | DDD MREM/H | CO58 CO | % LIGNE | TRONCONS DONT LA PARTICIPATION AU DDD EST > 20 % |
|---|---|---|---|---|
| RRA | 10.283 | 16.3/97 | 11.57 | 0.21 TR01 0.20 TR03 0.22 TR05 3 SUR 5 |
| BU | 2.522 | 16.8/98 | 2.84 | 0.46 TR30 0.23 TR31 0.21 TR 32 3 SUR 5 |
| RIS | 6.577 | 14.1/97 | 7.40 | 0.25 TR03 0.21 TR04 2 SUR 6 |
| BC | 19.492 | 5.90/98 | 21.93 | 0.94 TR02 1 SUR 2 |
| BF | 14.745 | 14.5/98 | 16.59 | 0 SUR 10 |
| BPA | 6.382 | 24.1/97 | 7.18 | 0 SUR 13 |
| BPB | 12.496 | 25.4/97 | 14.06 | 0 SUR 13 |
| BPC | 7.310 | 21.0/94 | 8.23 | 0 SUR 7 |
| SON | 5.199 | 22.2/94 | 5.85 | 0.57 TR02 0.22 TR03 2 SUR 4 |
| REN | 3.862 | 20.4/97 | 4.34 | 0 SUR 20 |
| TOTAL | 88.870 | | | |