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# EKO-5

# PREPLANNING OF EARLY CLEANUP

# FÖRPLANERING AV TIDIGA SANERINGSÅTGÄRDER

## Annual report 1996 / Årsrapport 1996

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# Summary

A prestudy "Preplanning of early cleanup after fallout of radioactive material" made by Studsvik EcoSafe has pointed out the need and request for preplanning of actions. Based on the prestudy this project was started with the goal to work out guidelines and checklists. Because of the common interest between the Nordic countries NKS is the organization responsible for the project.

The result of the project will be a document pointing out what can be planned in advance, including guidelines and checklists, regarding early cleanup actions after a nuclear plant accident in or in the vicinity of the Nordic countries. In this work 'early' means the three first weeks after an accident. The project only deals with questions concerning external radiation.
The document shall be usable by *persons in charge of planning* or *decision makers* on the appropriate level of organization for each country. The document shall principally be aimed towards persons without professional competence in the field of radiology.

The result will be presented for a limited number of generalized environments and fallout situations

- urban/ suburban/ rural (concentrating on urban/ suburban)
- regional differences (in for example house types and constructing material)
- dry or wet deposition

Calculations have been made by Risø National Laboratory, which are reported in NKS/EKO-5 (96) 18: "Evaluation of Early Phase Nuclear Accident Clean-Up Procedures for Nordic Residential Areas" Kasper G. Andersson, Risø National Laboratory, ISBN 87-550-2250-2.

In the report five housing environments, ten cleanup actions and wet or dry deposition are treated. For 66 combinations calculations are made and the results are documented as data sheets, each describing the beneficial effects, costs and disadvantages of application of a feasible method for cleaning in the early phase of a specific type of surface in one of five different urban or suburban environments. This data forms the foundation for the recommendations on guidelines, which are the ultimate goal of the EKO-5 project.

The calculations are done for detached houses (brick and wooden construction), semi-detached houses, terrace houses and multistorey block houses.
Based on the data sheets a compilation of information on countermeasures will be generated, containing data and guidelines which are considered relevant to develop a check-list for the local planners. This list only will include those countermeasures, which must be carried out in the early phase to be meaningful. They are: fire hosing of roads, fire hosing of walls, fire hosing of roofs, lawn mowing, pruning of trees and bushes, snow removal and vacuum sweeping of roads.

The rural environment will be treated in the same manner, but the effort will be much less compared to what is done regarding the urban and suburban environments. This is due to the fact that we consider rural areas as a lesser problem as long as you talk about preplanning. People can take actions by themselves after recommendations and have most of the equipment needed. Besides, it is a small part of the population that will be affected.

The project is scheduled to be terminated at March 31, 1997.

# Sammanfattning

En förstudie "Förplanering av tidiga saneringsåtgärder efter radioaktivt nedfall" gjord av Studsvik EcoSafe har pekat på behovet av och kraven på förplanering av åtgärder. Baserat på denna förstudie startades detta projekt med målet att utarbeta vägledning och checklistor. På grund av ett gemensamt nordiskt intresse har arbetet bedrivits inom ramen för NKS.

Projektets resultat skall bli ett dokument som pekar ut vad som kan planeras i förväg, inklusive vägledningar och checklistor, då det gäller tidiga saneringsåtgärder efter en kärnkraftsolycka i eller i närheten av Norden. 'Tidiga' betyder i detta fall de tre första veckorna efter en olycka. Projektet behandlar endast frågor som rör extern bestrålning. Dokumentet skall kunna användas av personer med ansvar för planering eller beslutsfattare på den relevanta organisationsnivån i respektive land. Dokumentet är främst avsett för personer utan professionell kompetens inom radiologiområdet.

Resultatet kommer att beskrivas för ett begränsat antal generella boendemiljöer och nedfallssituationer

- stad/förort/landsbygd (med tonvikt på stad/förort)
- regionala skillnader (i till exempel hustyper och konstruktionsmaterial)
- torr eller våt deposition

Beräkningar har gjorts av Risø National Laboratory, som har rapporterats i NKS/EKO-5 (96) 18: "Evaluation of Early Phase Nuclear Accident Clean-Up Procedures for Nordic Residential Areas" Kasper G. Andersson, Risø National Laboratory, ISBN 87-550-2250-2.

I rapporten behandlas fem boendemiljöer, tio saneringsåtgärder och torr eller våt deposition. För 66 kombinationer har beräkningar gjorts och resultatet är dokumenterat som datablad. Vart och ett beskriver nyttan, kostnader och nackdelar då saneringsmetoden appliceras i en tidig fas på en specifik yta i någon av de fem boendemiljöerna. Dessa data utgör grunden för den vägledning som är målet med EKO-5 arbetet.

Beräkningarna är gjorda för enfamiljshus (med trä- och tegelfasad), parhus, våningshus och mångvåningshus i stadskärnor.
Baserat på databladen kommer en sammanställning av åtgärder att skapas, innehållande data och vägledning, relevant som checklista för den lokale planeraren. Listan kommer endast att innehålla de åtgärder som måste utföras i ett tidigt skede för att vara meningsfulla. Dessa är: spolning av vägar, väggar och tak, gräsklippning, klippning av träd och buskar, borttagande av snö och vacuumsugning av gator.

Landsbygdsmiljön kommer att behandlas på samma sätt, men omfattningen kommer att vara betydligt mindre än för stads- och förortsmiljö. Skälet är främst att behovet av samhällelig planering är mindre, eftersom de boende själva kan genomföra rekommenderade åtgärder och har den mesta utrustningen som krävs.

Projektet skall vara avslutat den 31 mars 1997.

# Introduction

A prestudy "Preplanning of early cleanup after fallout of radioactive material" made by Studsvik EcoSafe pointed out the need and request for preplanning of actions. The prestudy proposed that a main study should be started to propose test methods, elaborate scenarios, describe relevant cleanup strategies in different environments and to prepare a checklist. Based on the prestudy and on discussions this project was started on April 1, 1996. Because of the common interest between the Nordic countries NKS is the organisation responsible for the project.

During the year we have had three project meetings. After the two first meetings we had decided that the result of the project will be a document pointing out what can be planned in advance, including guidelines and checklists, regarding early cleanup actions after a nuclear plant accident in or in the vicinity of the Nordic countries. In this work 'early' means the three first weeks after an accident. The relevant parameter to valuate the benefit of a clean-up action is the reduction in life time dose, that can be achieved by that action. For that reason the project only deals with questions concerning external radiation from the long-lived nuclide $^{137}Cs$. Internal doses from inhaled nuclides during the passage of the radioactive cloud is of course a risk that must be avoided, for example doses to thyroidea from inhaled radioactive iodine, but these effects must be avoided by other means than clean-up actions. External doses from short-lived nuclides or internal doses still have to be considered in one respect, they can constitute a radiation hazard to the clean-up teams, making it necessary to plan for radiation protection. For the selected actions where radiation protection concerns can arise, this will be pointed at in the guidelines.
The document shall be usable by *persons in charge of planning* or *decision makers* on the appropriate level of organisation for each country. The document shall principally be aimed towards persons without professional competence in the field of radiology.

We also decided that he result will be presented for a limited number of generalized environments and fallout situations

- urban/ suburban/ rural (concentrating on urban/ suburban)
- regional differences (in for example house types and constructing material)
- dry or wet deposition

Based on the discussions and according to a agreement between EKO-5 and Risø forskningscenter calculations have been made by Risø, which are reported in NKS/EKO-5 (96) 18 (see below under Documents produced).
In the paper five housing environments, ten cleanup actions and wet or dry deposition are treated. For 66 combinations calculations are made and the results are documented as data sheets, each describing the beneficial effects, costs and disadvantages of application of a feasible method for cleaning in the early phase of a specific type of surface in one of five different urban or suburban environments. This data forms the foundation for the recommendations on guidelines, which are the ultimate goal of the EKO-5 project.

The calculations are done with URGENT, a model developed by Risø.
The environments are according to 'Gamma exposures due to radionuclides deposited in urban environments. 1.Kerma rates from contaminated urban surfaces' by Meckbach, R; Jacob, P and

Paretzke, H.G.. From this paper four environments were choosen: detached, semi-detached, terrace houses and multistorey block houses. The detached house in the reference is with brick stone construction, and as a need was recognised to have data for wooden houses also the necessary modifications have been made, to give data for both wooden and brick construction houses.

At the third meeting we discussed the result from the calculations and which of the combinations we considered as relevant for the final report. They are hosing of roofs, walls and paved areas, crass cutting, snow removal and pruning of trees and bushes.

The project was presented at the NSFS/Radioecology meeting in Reykjavik in August and has two times been presented and discussed in the Swedish national expert group on decontamination.

# Inledning

En förstudie "Förplanering av tidiga saneringsåtgärder efter radioaktivt nedfall" gjord av Studsvik EcoSafe pekade på behovet av och kraven på planering av åtgärder. Förstudien föreslog att en huvudstudie skulle starta med uppgift testmetoder, utveckla scenarier, beskriva relevanta saneringsåtgärder i olika miljöer och att utarbeta en checklista. Utgående ifrån förstudien och diskussioner startades projektet den 1 april 1996. På grund av det gemensamma intresset hos de nordiska länderna är NKS ansvarig organisation för projektet.

Under året har vi haft tre projektmöten. Efter de två första fanns beslut att resultatet av projektarbetet skall vara ett dokument som identifierar vad som kan planeras i förväg, inklusive vägledning och checklista, beträffande tidiga saneringsåtgärder efter en kärnkraftsolycka i eller i närområdet av Norden. Med tidiga menar vi de tre första veckorna efter olyckan. Projektarbetet skall endast behandla extern bestrålning. Interna doser från inandade nuklider under molnpassagen är naturligtvis en risk som måste undvikas, till exempel doser till sköldkörteln från inandat radioaktivt jod, men dessa effekter måste undvikas med andra medel än med saneringsåtgärder. Externa doser från kortlivade nuklider eller interna doser måste emellertid ändå beaktas i ett avseende, de kan utgöra en strålrisk för saneringspersonalen som gör det nödvändigt att utarbeta en strålskyddsplan. För de åtgärder där strålskyddsproblem kan uppstå kommer detta att påpekas i vägledningen. Dokumentet skall vara användbart för *personer med ansvar för planering* eller *beslutsfattare* på relevant organisationsnivå i respektive land. Det skall inriktas mot personer utan professionell kompetens inom radiologiområdet.

Vidare beslöt vi att resultatet skall presenteras för ett begränsat antal generaliserade miljöer och nedfallssituationer

- stad/ förort/ landsbygd (med koncentration på stad/ förort)
- regionala skillnader (i till exempel hustyper och konstruktionsmaterial)
- torr eller våt deposition

Utgående ifrån diskussionerna och enligt avtal mellan EKO-5 och Risø forskningscenter har beräkningar gjorts av Risø, vilka är rapporterade i NKS/EKO-5 (96) 18 (se nedan under Documents produced).
Rapporten behandlar fem boendemiljöer, tio saneringsåtgärder och våt eller torr deponering. För 66 kombinationer har beräkningar gjorts och resultatet är dokumenterat som datablad där var och en av dem beskriver nyttan, kostnader och nackdelar vid tillämpningen av metoden i ett tidigt skede i en av fem olika boendemiljöer. Dessa data utgör grunden för utarbetande av den vägledning som är målet för arbetet inom EKO-5 projektet.
Beräkningarna är gjorda med URGENT, en modell som är utvecklad på Risø.

Boendemiljöerna är enligt 'Gamma exposures due to radionuclides deposited in urban environments. 1.Kerma rates from contaminated urban surfaces' by Meckbach, R; Jacob, P and Paretzke, H.G.. Fyra miljöer har valts ut: friliggande, parhus, våningshus och blockhus med många våningar. För friliggande hus anges tegelsten som konstruktionsmaterial, men eftersom det visade sig finnas ett behov att ha data även från trähus, har de nödvändiga kompletteringarna gjorts för att beräkna data för både trä- och stenhus.

Vid det tredje mötet diskuterade vi resultaten från beräkningarna och vilka av kombinationerna vi ansåg vara relevanta för slutrapporten. De är spolning av tak, väggar och asfaltytor, att klippa gräs, ta bort snö samt att kvista träd och buskar.

Projektet presenterades vid NSFS/Radioekologimötet i Reykjavik i augusti och har föredragits och diskuterats två gånger i den svenska nationella expertgruppen för sanering.

# Results for 1996

The character of the project EKO-5 is not a traditional research project, so the purpose is not to produce scientific reports. As has been said in the introduction the purpose is to perform guidelines and to produce checklists. There are lots of technical and scientific results from research and development activities, which we will use as references for the final product.

Within the frame of the EKO-5 a report has been written by Risø. NKS/EKO-5 (96) 18: "Evaluation of Early Phase Nuclear Accident Clean-Up Procedures for Nordic Residential Areas" Kasper G. Andersson, Risø National Laboratory, ISBN 87-550-2250-2.

*Extract from the report*
The report describes the expected effects, in terms of immediate dose rate reduction and of reduction of the integrated doses over 70 years, of implementation of the methods which were considered to be feasible for early phase treatment of contaminated urban surfaces. Also given are estimates of the integrated doses if no action were taken.

The given estimates were based on the experience obtained through large amounts of in situ measurements on different types of surface, mainly since the Chernobyl accident in 1986. The URGENT model, which was developed at Risø mainly on the basis of this in situ measurement data, was one of the very first dynamic external dose models to comprise the whole urban environment in the event of an accidental contamination with radiocaesium. It was, for instance, the first extensive model to take into account the contamination on trees and vegetation, which has proved to be a potentially important factor in dry deposition scenarios. The model uses the results of Monte Carlo photon transport calculations to link the time-dependent radio-contaminant concentrations to dose rates to persons staying at different locations in different housing environments of varying population density.

The URGENT model was used together with practical experience from semi-large scale decontamination testing to evaluate the feasible remedial countermeasures when applied in the early phase. The modelled scenarios reflect what is considered to be typical situations in the Nordic countries with areas of varying population density (from small single-family houses made of wood or brick to multi-storey house blocks) and varying weather conditions at deposition.

Chapter 2 explains how the calculations of doses and dose rates were performed and which assumptions were made, whereas Chapter 3 is aimed at giving the decision maker the ability of applying the data sheets in the decision-making process by weighting factors that need to be considered in the formation of a decontamination strategy.

Chapter 4 describes the mechanisms that are responsible for the dose contributions received from contaminated indoor surfaces. These are treated separately from the outdoor-originating dose contributions, as there is no distinct correlation between the size of the house and the parameters influencing indoor aerosol deposition.

Chapter 5 describes disposal techniques for the radioactive waste that is generated by some of the decontaminating countermeasures. A list of relevant literature for further information in this relation is given at the end of the chapter.

Chapter 6 of the report consists of 66 data sheets, each describing the beneficial effects, costs and disadvantages of application of a feasible method for cleaning in the early phase of a specific type of surface in one of five different urban or suburban environments. This data forms the foundation for the recommendations on guidelines, which are the ultimate goal of the EKO-5 project. Two references to particularly recommendable supplementary literature are given to each data sheet. A full list of these references is given in Chapter 7.

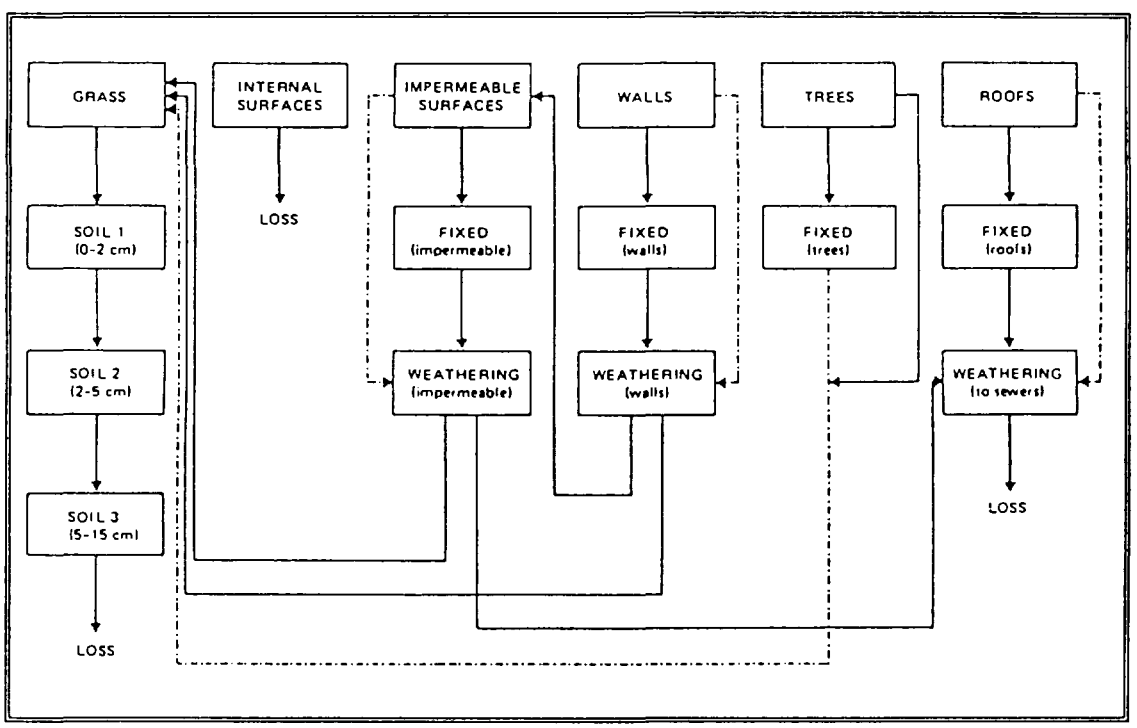
References are given to recommended supplementary reading.

The dynamic part of the model URGENT is mainly based on the linear compartment model theory. Thus, the transfer rate for radioactive matter following deposition on a given type of surface, m, can be written as:
in which $X_m$ and $X_n$ represent the radioactive matter in compartments m and n, respectively, at a time t. $S_{nm}$ is the transfer coefficient from compartment n to m. $L_m$ is the transfer coefficient for flow of radioactivity out of the system, etc. (for instance, loss by radioactive decay).

$$\frac{dX_m}{dt} = \sum_{n=1}^{P} S_{nm} X_n - \left(\sum_{n=1}^{P} S_{mn}\right) X_m - L_m X_m$$

The flow diagram (Figure 2.5) shows the principle of the migration model with its assumptions. The dotted lines indicate processes taking place as discrete events. The term 'impermeable surfaces' means all horizontal surfaces that are not easily penetrated by water, such as asphalt and concrete.

Figure 1: URGENT contamination flow chart.



The 'internal surfaces' compartment contains the amount of radioactive matter deposited on the internal surfaces of buildings and on furniture and furnishings. The internal surfaces have been dealt with separately in a special section as there is no distinct correlation between the size and shape of a house with surroundings and the parameters influencing indoor deposition of radioisotopes.

For those 'hard' surfaces on which weathering processes are likely to cause a migration of caesium contamination from one type of surface to another (paved horizontal surfaces, walls and roofs), the migration/retention is accommodated by splitting the radioactive matter into three 'pools'. These represent three different states at which radioactive substances may be found on the particular surface. The first is the mobile phase representing part of the initially dry-deposited material. The second state is the more strongly bound. Weathering processes will however mobilize the material in this state, and it is here the third state arises, representing the remobilized material.

For the contamination deposited on trees the model structure is different. Here, a slow transfer of activity from the trees to the grass due to the effects of wind and rain is taken into account in the model. A loss by leaf-fall from deciduous trees is modelled over the autumn.

The input parameters in URGENT are, where possible, based on experimental results, mainly obtained after the Chernobyl accident. A more extensive description of the models applied to calculate doses and dose rates is given in the European Commission report EUR 16604 EN, ISBN1018-5593, 1995.

All doses and dose rate contributions in the data sheets in Chapter 6 are given per 1 $MBq/m^2$ $^{137}Cs$ initially deposited on a grassed surface, so as to facilitate a scaling to the actual contamination levels.

The 'immediate averaged total dose rate reduction in the area' is the percentage reduction of the total averaged dose rate level (to which there are contributions from different types of surface) which can be achieved immediately by implementing a countermeasure shortly after the contaminant deposition. The averaging is with respect to the location of the people in the area.

The 'averaged total accumulated lifetime dose reduction over 70 years' is an estimate of the percentage reduction achievable by a countermeasure of the total accumulated dose (total of dose contributions from different surfaces) to a person who stays in the area for 70 years. This is also averaged with respect to the location of the people in the area.

The 'averaged total accumulated lifetime doses to people living in the area' are estimates of the location averaged total doses received by a person staying in the area for 70 years if no countermeasures were implemented to reduce the dose.

Other parameters given in the data sheets are almost exclusively based on knowledge obtained through experimental investigations. For each data sheet, references are given to relevant literature.
*End of extract*

As an example the data sheet for house type detached wooden, dry deposition and lawn moving is given below.

*Region:* Suburban or urban
*House type:* Detached wooden
*Weather conditions at deposition:* Dry
*Surface type:* Grassed garden areas

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*Clean-up action:* Lawn mowing (Literature 5, 6)

In a dry deposition case, lawn mowing is an efficient decontamination procedure in the early phase. If the grass is not extremely short at the time of deposition, the radiocaesium aerosol deposition to a grassed area will be significantly higher than that to an area of bare soil (in some cases more than 6 times as much). The transfer process of deposited radiocaesium from the grass to the underlying soil has a half-life of 7 days (at 11mm rain/week) to 15 days (dry weather), so it is important to get started immediately. Naturally, the cut-off grass must be removed from the lawn.

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*Expected effect:* Immediate averaged total dose rate reduction in the area by about 35-40 %, if carried out within the first few days following deposition. Averaged total accumulated lifetime dose reduction over 70 years by ca. 60 %. The open (grassed) areas contribute about 47 % of the dose rate in the early phase - or in other terms: 26 μGy/d per 1 MBq/m$^2$ of $^{137}$Cs deposited to a lawn. The averaged total accumulated lifetime dose to people living in the area would amount to ca. 186 mGy per 1MBq/m$^2$ initially deposited to a lawn if no action were taken.

*Personnel requirements and costs:* The procedure could be carried out by the local inhabitants. It is assumed that the procedure could be carried out at a speed of ca. $2 \bullet 10^{-4}$ man-days per treated m$^2$ - plus an additional 0.003 man-days/m$^2$ to remove the grass by rake. Overheads are estimated to 100 % of the manpower costs.

*Equipment / other requirements and costs:* The ordinary household lawn mower (estimated price: 600 ECU (petrol operated) or 150 (manually operated)) will normally be readily available for the task Consumables for the motorized version would amount to ca. 2 l/h of petrol.

*Practicability:* The procedure could be carried out at large scale in inhabited areas.

*Waste - amounts and costs:* The amount will depend on the length and density of the removed grass (on average about 600 l/ha). The costs for transportation and final storage of waste at a repository at a distance of less than 20 km are estimated to be in the order of 400 ECU/ha.

*Further remarks:* It is important to cut the grass as short as possible, and that practically all cut-off grass is removed.

The housing environments used are as shown in figures 2.1 - 2.4, as they are given by R. Meckbach, P. Jacob and H.G. Paretzke, 1988

*Fig.2.1: Detached single-family house area*

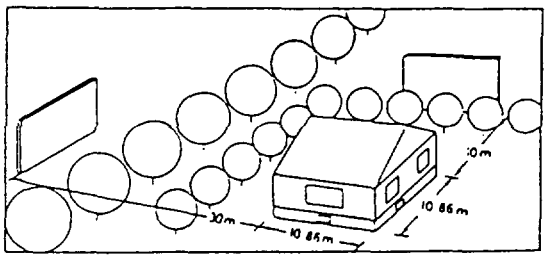



*Fig.2.2: Semi-detached house area*

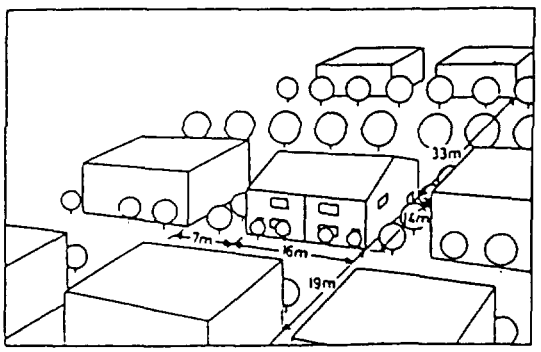



*Fig.2.3: Terrace (row) house area*

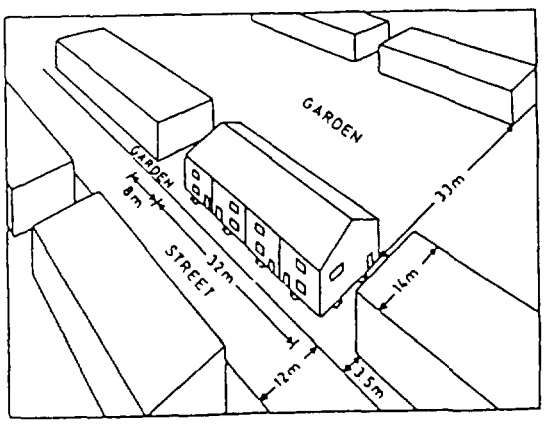
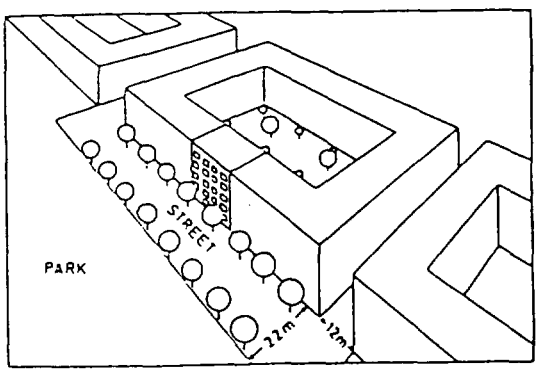



*Fig.2.4: Multistorey building area*



The following two tables shows for which combinations calculations have been performed.

(1) detached, wooden construction (fig 2.1)
(2) detached, brick construction (fig 2.1)
(3) semi-detached (fig 2.2)
(4) terrace houses (fig 2.3)
(5) multistorey block houses (fig 2.4)

Table 1 Dry deposition

| **Action; Housing env →** ↓ | **1** | **2** | **3** | **4** | **5** | | | **Σ** |
|---|---|---|---|---|---|---|---|---|
| Fire hosing of roads | | | | X | X | | | 2 |
| Fire hosing of roofs | X | X | X | X | | | | 4 |
| Fire hosing of walls | X | X | X | X | X | | | 5 |
| Grass cutting | X | X | X | X | X | | | 5 |
| Ploughing | | | | | X | | | 1 |
| Pruning of trees and bushes | X | X | X | X | X | | | 5 |
| Snow removal | X | X | X | X | X | | | 5 |
| Soil removal | X | X | X | X | X | | | 5 |
| Triple digging | X | X | X | X | X | | | 5 |
| Vacuum-sweeping of roads | | | | X | X | | | 2 |
| | | | | | | | | 39 |

Table 2 Wet deposition

| **Action; Housing env →** ↓ | **1** | **2** | **3** | **4** | **5** | | | **Σ** |
|---|---|---|---|---|---|---|---|---|
| Fire hosing of roads | | | | X | X | | | 2 |
| Fire hosing of roofs | X | X | X | X | | | | 4 |
| Fire hosing of walls | | | | | | | | 0 |
| Grass cutting | | | | | | | | 0 |
| Ploughing | | | | | X | | | 1 |
| Pruning of trees and bushes | X | X | X | | | | | 3 |
| Snow removal | X | X | X | X | X | | | 5 |
| Soil removal | X | X | X | X | X | | | 5 |
| Triple digging | X | X | X | X | X | | | 5 |
| Vacuum-sweeping of roads | | | | X | X | | | 2 |
| | | | | | | | | 27 |

The task for the project is to work out guidelines and check lists for *early* clean-up actions, and one important question that has been discussed is which of the 10 actions that are relevant to use in our work. Reduction of the life time dose is the most important effect to achieve by the action. Grass cutting and snow removal can give large effects, but has to be done a very short time after the deposition to be meaningful and were put on the list of relevant actions. Fire hosing and vacuum sweeping should be done early before the deposition is fixed to the surface and these actions are also put on the list on relevant early cleanup actions. Finally, with some hesitation, the pruning of trees and bushes were put on the list.

Not on the list are ploughing, soil removal and tripple digging.

# Documents produced

According to commissions given by the EKO-5 project the following two documents have been produced:

NKS/EKO-5 (96) 18: "EVALUATION OF EARLY PHASE NUCLEAR ACCIDENT CLEAN-UP PROCEDURES FOR NORDIC RESIDENTIAL AREAS" Kasper G. Andersson, Risø National Laboratory

NKS/EKO-5 (96) 20: "SANERINGSÅTGÄRDER I NORDEN-AKTUELLA RADIONUKLIDER" Lennart Devell, Studsvik Eco&Safety AB

A complete list of documents is given in an appendix.

# Work to be done in 1997

The seven actions that have been picked out as relevant for the task of the project, will be treated by two subgroups with the purpose to translate each of them into guidelines and checklists.

The rural environment will be treated in the same manner, but the effort will be much less compared to what will be done regarding the urban and suburban environments. This is due to the fact that the projectgroup consider rural areas as a lesser problem as long as you talk about preplanning. People can take actions by themselves after recommendations and have most of the equipment needed. Besides, it is a small part of the population that will be affected.

The final report will be written containing the resulting guidelines and checklists and with the Risø report as an appendix. The final manuscript is scheduled to be ready on March 31.

We hope to be able to present the results in national seminars, but at least in one common Nordic seminar. This is outside the frame for the initial setup of the project and must therefore be discussed and accepted by the parties. A suitable time for these seminars is early in the autumn of 1997.

About one personmonth will be used by the project leader during the first quarter of 1997. Most of the time will be spent to coordinate the work in the subgroups and to write and edit text for the final report. Some time will be spent on calculations for rural areas.

# Economy

The project is divided into five parts according to what is shown below. Parts 5.1 - 5.3 are finalised, the part 5.4 goes over the turn of years 96/97 and part 5.5 will run in 1997.

EKO-5.1 Initial discussions and contact activities
EKO-5.2 Relevant scenarios and environments
EKO-5.3 Effects and cost of different actions
EKO-5.4 Performance of the final document, inclusive guidelines and checklists
EKO-5.5 Finishing national seminars and spread of information

Budget (thousands of SEK)

| 1996 | project-managing | travels | consults | other | part-sum |
|---|---|---|---|---|---|
| EKO-5.1 | 50 | 40 | 0 | 35 | 125 |
| EKO-5.2 | 50 | 30 | 0 | 20 | 100 |
| EKO-5.3 | 25 | 30 | 250 | 0 | 305 |
| EKO-5.4 | 50 | 15 | 0 | 15 | 80 |
| EKO-5.5 | 0 | 0 | 0 | 0 | 0 |
| SUM | 175 | 115 | 250 | 70 | 610 |

| 1997 | project-managing | travels | consults | other | part-sum |
|---|---|---|---|---|---|
| EKO-5.1 | 25 | 20 | 0 | 15 | 60 |
| EKO-5.2 | 0 | 0 | 0 | 0 | 0 |
| EKO-5.3 | 0 | 0 | 30 | 0 | 30 |
| EKO-5.4 | 75 | 15 | 0 | 60 | 150 |
| EKO-5.5 | 50 | 10 | 0 | 50 | 110 |
| SUM | 150 | 45 | 30 | 125 | 350 |
| TOTSUM | 325 | 160 | 280 | 195 | 960 |

There are no significant deviations between real costs and budget for 1996.

National financing to support the project (participating in meetings, working time, travelling etc.) can be estimated to 250 000 SEK.

# Project group

Thomas Ulvsand, FOA, Sweden, project leader
Kasper G Andersson, Risø, Denmark
Jørgen Holst Hansen, Beredskabsstyrelsen, Denmark
Jan Preuthun, Statens Jordbruksverk, Sweden
Kari Sinkko, STUK, Finland
Gun Svennerstedt, Statens Räddningsverk, Sweden
Svein Uhnger, Statens strålevern, Norway

# List of documents

| Reg nummer | Datum | Titel | Filnamn.doc |
|---|---|---|---|
| NKS/EKO-5 (96) 5 | 960522 | Kallelse till ett första möte inom EKO-5 | kalle1 |
| NKS/EKO-5 (96) 6 | 960522 | First meeting with the EKO-5 working group | summons |
| NKS/EKO-5 (96) 7 | 960619 | Half yearly report, spring 96 | halvår |
| NKS/EKO-5 (96) 8 | 960624 | Halvårsrapport, våren 96 | halvrapp |
| NKS/EKO-5 (96) 9 | 960627 | The EKO-5 project, background, purpose and disposition of the final report | redovisn |
| NKS/EKO-5 (96) 10 | 960628 | Memorandum (möte 11 - 12 juni) | memo_app |
| NKS/EKO-5 (96) 11 | 960719 | Avtal med Risø | avtal m Risø |
| NKS/EKO-5 (96) 12 | 960814 | Abstract (inför Islandsmötet) | abstract |
| NKS/EKO-5 (96) 13 | 960820 | Kallelse till ett andra möte inom EKO-5 | summons2 |
| NKS/EKO-5 (96) 14 | 960920 | Memorandum (möte 3 september) | memo2 |
| NKS/EKO-5 (96) 15 | 961030 | Fastställd indelning och budget | indelning och. |
| NKS/EKO-5 (96) 16 | 961108 | Kallelse till tredje mötet inom EKO-5 | summons3 |
| NKS/EKO-5 (96) 17 | 961210 | Memorandum (möte den 18 - 19 november) | memo3 |
| NKS/EKO-5 (96) 18 | | Risørapport | |
| NKS/EKO-5 (96) 19 | 961220 | Årsrapport 1996, utkast | årsrapport96 |
| NKS/EKO-5 (96) 20 | 961111 | Saneringsåtgärder i Norden, PM från Lennart Devell, Studsvik EcoSafe | |

# Acknowledgement

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