Management of occupational exposure for pregnant workers in the medical field in Spain

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Abstract

Spanish Government has recently approved new regulations on ionizing radiation, transposing most of the provisions of Directive 96/29 Euratom. For pregnant workers the regulations require that, once the employer has been notified, it will be unlikely that the equivalent dose to the fetus exceed 1 mSv during the remainder of the pregnancy.

The radiation dose to the fetus cannot be directly measured. In order to avoid this ambiguity, ICRP'60 proposed a supplementary limit of 2 mSv to the dose to the surface of the abdomen of the pregnant woman during the remainder of the pregnancy. Unfortunately this proposal has not been considered either by the European Directive or by the Spanish regulations.

In order to clarify the management of occupational exposure of pregnant workers in the medical field, a commission integrated by representatives of the Spanish Consejo de Seguridad Nuclear, the national authority in the radiation protection field, and the Spanish Societies of Radiation Protection and Medical Physics have prepared an additional guidance, including practical recommendations directed to pregnant workers, to the employers as well as to the employment medical advisers.

Furthermore a classification of working places in the medical field where pregnant women can work has been established. Finally a reference level of the dose to the surface of the abdomen has been introduced in order to ensure the observance of the dose limit to the fetus.

1. Introduction

The basis for the control of the occupational exposure of women who are not pregnant is the same as that for men. However, if a woman is, or may be, pregnant, additional controls have to be considered to protect the unborn child. Several factors complicate this matter. The fetus is at times more prone than the post-natal individual to deterministic injuries caused by radiation and may be more sensitive to the induction of later malignancies.

The protection methods for female workers who may be pregnant should provide a standard of protection for any fetus broadly comparable with that provided for members of the general public. In the application of this special protection it is important not to create unnecessary discrimination against pregnant women.

This problematic is especially relevant in the medical sector where a great number of exposed young women, liable to become pregnant, are employed. Therefore, within the Radiological Protection Forum in the Medical Field, presented in another paper in this Workshop, integrated by the Spanish Nuclear Safety Council, the Spanish Radiation Protection Society and the Spanish Medical Physics Society, a specific working group on this subject has been created. In this paper the main conclusions of this working group are presented:

- Risks associated to the prenatal exposure to ionizing radiation.
- Dose limits to be applied in such situations.
- Restrictions of the occupational exposure of pregnant women.
- Guidelines for the monitoring of the doses received by the pregnant women.
- Basic information to be given to the women occupationally exposed to ionizing radiation in the medical field.
- Adequate information to be given to the medical staff in charge of the medical surveillance of the exposed pregnant women.

2. Risks associated to a prenatal radiation exposure.

Two guides, one of them intended to the gynaecologists, obstetricians, and medical professionals in charge of the medical surveillance of exposed workers and the other to the pregnant workers, have been prepared. In each one the main risks associated to a prenatal radiation exposure are described. Both guides are included as annexes at the end of this paper.

3. Limits and restrictions to be applied to the occupational exposure of pregnant workers.

The basic recommendations of ICRP-60 establish that the methods of protection at work for women who may be pregnant should provide a standard of protection for any conceptus broadly comparable with that provided for members of the general public, for which it establishes an annual limit on effective dose of 1 mSv. On this basis, once pregnancy has been declared, the conceptus should be protected by applying a supplementary equivalent-dose limit to the surface of the woman's abdomen (lower trunk) of 2 mSv for the remainder of the pregnancy and by limiting intakes of radionuclides to about 1/20 of the ALI.

An important aspect to mention is that this dose limit recommended by ICRP-60 constitutes a much more restrictive policy than the previous recommendations of ICRP-26, where a dose limit to the fetus of 10 mSv since the pregnancy declaration was established. It must be pointed out that the new policy of ICRP is based in ethical considerations rather than in scientific evidences of biological effects to the fetus due to ionizing radiation. In fact the Commission's policy is that the fetus should be considered as a member of the general public, since the unborn child has not made any decision and he does not receive any benefit from the exposure. Therefore, this decision is not due to any new scientific evidence of a higher risk to the fetus due to the mother's exposure to radiation, but to a reclassification as a member of the public.

In a later publication, ICRP-75, an additional consideration is introduced since, in the opinion of the Commission, ICRP-60 recommendations in relation to protection of pregnant workers had been interpreted in a very restrictive way. The Commission points out that, rather than establishing a rigid dose limit for the conceptus of a pregnant worker, the working conditions of the pregnant worker, after the declaration of pregnancy, should be as such to make it unlikely that the additional dose to the conceptus will exceed 1 mSv during the remainder of the pregnancy.

In this publication ICRP clarifies as well that this dose restriction to the fetus does not mean that it is necessary for pregnant women to avoid work with radiation or radioactive materials completely. It does however imply that their employer should carefully review the exposure conditions of pregnant women. In particular, their employment should be of such a type that the probability of high accidental doses and radionuclide intakes is insignificant.

In the same line as the ICRP recommendations, the Council Directive 96/29/EURATOM laying down basic radiation protection standards in the European Union states that "as soon as a pregnant woman declares her condition the protection of the child to be born shall be comparable with that provided for members of the public. The conditions for the pregnant woman in the context of her employment shall therefore be such that the equivalent dose to the child to be born will be as low as reasonably achievable and it will be unlikely that this dose exceed 1 mSv during at least the remainder of the pregnancy".

These points in the Directive have been literally incorporated into the Spanish legislation and they are included in the article 10 of the Royal Order 783/2001 where the Regulation on the protection of health against ionizing radiation is approved.

However, unfortunately, neither the European Directive nor the Spanish regulation have established any practical way of individual monitoring to assess exposure of the fetus. Consequently it should be wise to retake the supplementary dose limit to the surface of the abdomen of the pregnant woman proposed by ICRP-60, as a practical limit that guarantees that the fetal dose is lower than the regulated dose limit.

As a summary, a pregnant exposed worker should take into account the following:

- Pregnancy does not mean discontinuing of work.
- The working conditions for the pregnant woman must be such that it will be unlikely that the equivalent dose to the fetus exceed 1 mSv during at least the remainder of the pregnancy. The application of this limit

in practice, corresponds to a supplementary equivalent-dose limit to the surface of the woman's abdomen (lower trunk) of 2 mSv for the remainder of the pregnancy.
- Any working activity involving any significant risk of bodily radioactive contamination should be avoided

4. Considerations on workplaces in the medical field.

The essential elements of an acceptable program of evaluation and control of the radiation doses that can be received by an embryo/fetus of a pregnant exposed worker are the following:

- Voluntary pregnancy declaration including estimated date of conception.
- Evaluation of the working conditions of the pregnant worker and the risks, which she is exposed to.
- Working restrictions, if any, to the pregnant worker.

4.1 Pregnancy declaration

The first responsibility for the protection of the conceptus lies with the woman herself to declare her pregnancy to her management as soon as the pregnancy is confirmed.

Once the pregnancy is declared it is responsibility of the employer to organise the working conditions of the worker to make it unlikely that the equivalent dose to the surface of the woman's abdomen (lower trunk) will exceed 2 mSv during the remainder of the pregnancy. Moreover, the employer must guarantee that the pregnant worker has been informed on the potential risks in her employment and on the dose limits that apply, providing her any advice or assistance she would need.

Rights and privacy of the pregnant worker must be assured before, during and after her pregnancy declaration.
In the annexe an example of pregnancy declaration form is presented.

4.2 Evaluation of the working conditions.

Once informed of the pregnancy the employer together with the pregnant woman must evaluate the work situation, taking into account the doses received during the previous months by her or other exposed workers doing a similar job. They must decide whether the equivalent dose to the surface of the abdomen in the remaining part of the pregnancy will

A: with certainty will be less than 2 mSv
B: is likely to be less than 2 mSv or
C: is likely to be above 2 mSv.

In the case of A no change need to be made in the work situation.

In the case of B the worker can continue with her normal work, but initiatives might need to be taken to reduce the probability of possible exposure.

In the case of C the worker will have to be transferred to other work, which will place her in the work situation A or B.

It will be necessary a close cooperation among the physician in charge of the medical surveillance of exposed workers, the radiation protection officer and the employer.

4.3 Working restrictions

In the following the different working places in Diagnostic Radiology, Nuclear Medicine and Radiotherapy departments are reviewed, pointing out the applicable restrictions in each case.

4.3.1 Diagnostic Radiology

In general a pregnant worker (physician, technician or nurse) can continue doing her job in the Diagnostic Radiology department as long as she stays behind structural protection barriers, since in this case it is very unlikely that the dose in the surface of the abdomen would exceed 2 mSv.

On the contrary she SHOULD NOT work in all those situations in which there were no structural protection barriers to protect her. This recommendation applies to fluoroscopy and mobile radiographic and fluoroscopic screening equipment.

Pregnant workers SHALL NOT participate in any emergency programme in the department.

The basic protection measures to be applied are the following:

- The pregnant worker must stay behind the protective barrier during the examination.
- She must wear her dosemeter on the abdomen.
- She must not stay inside any exploration room during an examination, unless it is strictly necessary, in which case she must wear a lead apron.

4.3.2 Nuclear Medicine

In this kind of installations the risk of internal contamination has to be considered in addition to external exposure. It will be necessary to avoid any working activity involving a significant risk of bodily radioactive contamination.

The basic protection measures to be applied are the following:

- Use disposable gloves while handling radioactive materials when feasible
- Wear lab coats or other protective clothing whenever there is a possibility of spills.
- Do not smoke, eat, drink or apply cosmetics around radioactive material.

Pregnant workers SHALL NEITHER handle radiopharmaceuticals in controlled areas NOR participate in the care of patients under metabolic therapy. On the other hand, they SHOULD NOT administer or inject radiopharmaceuticals to patients.

Pregnant workers SHALL NOT participate in any emergency programme in the department.

4.3.3 Radiotherapy

In the Radiotherapy departments it should be distinguish between teletherapy equipments (cobalt-60 units and linear accelerators) and the brachytherapy sources or equipments (manual and automatic after-loading techniques)

Linear accelerators and automatic after-loading brachytherapy

Due to the working conditions of these equipments it is very unlikely that the dose in the surface of the abdomen would exceed 2 mSv, consequently pregnant workers could continue with their jobs.

Pregnant workers SHALL NOT participate in any emergency programme in the department.

Cobalt Units

Pregnant workers SHALL NOT work in cobalt units due to the possibility of the source failing to return automatically to the safe position, which would imply her intervention as an emergency.

Manual brachytherapy

Pregnant workers SHALL NOT handle radioactive sources in the manual brachytherapy techniques. Furthermore, they SHOULD NOT participate in the care of patients being treated with these techniques.

4.3.4 Special situations

In order to avoid any working discrimination against pregnant women it can be considered that, with exceptional character, working of pregnant women could be allowed in the following cases:

- Mobile radiographic X-ray equipments,

- Fixed and mobile fluoroscopic X-ray equipments,
- Administration and injection of radiopharmaceuticals in nuclear medicine departments,
- Nursing of patients under treatment with manual brachytherapy techniques.

if the pregnant worker has voluntarily declared her decision of continuing with her job and provided that the working conditions make it unlikely that the equivalent dose to the surface of the woman's abdomen (lower trunk) will exceed 2 mSv during the remainder of the pregnancy. A radiation protection service will verify those conditions, supervising it during the remainder of the pregnancy.

5. Control measures and monitoring requirements

According to the Regulation on the protection of health against ionizing radiation, individual monitoring should be performed for pregnant exposed workers to guarantee that it is unlikely that the equivalent dose to the surface of the woman's abdomen will exceed 2 mSv during the remainder of the pregnancy.

5.1 Dosimetry in external exposure

Determination of the equivalent dose received by the child to be born is not possible and, moreover, ICRU has not given any advice on how to assess doses to the surface of the abdomen of pregnant women.

In view of this situation, it has been considered that estimation of dose to the surface of the abdomen should be done from the determination of the personal equivalent dose $H_p(10)$ to the abdomen of the pregnant worker. Consequently, once her pregnancy has been declared and during the remainder of it, doses to the abdomen of the pregnant woman will be estimated using an individual dosemeter placed on her abdomen.

- If assessment of exposure of the pregnant worker was done from monitoring of her workplace, and therefore, she was not using any individual dosemeter, she should be provided with an individual dosemeter, to be placed on her abdomen, during the remainder of the pregnancy.

- If assessment of exposure of the pregnant worker was done from individual monitoring, she will be provided with a second individual dosemeter, to be placed on her abdomen, during the remainder of the pregnancy.

In general, only one individual dosemeter placed on the abdomen would be adequate for estimation of both doses, to the whole body and to the abdomen. However in medicine there can be working places where radiation fields could be inhomogeneous enough so as to provide different values for both magnitudes. Therefore we recommend to use two dosemeters, one placed on the abdomen, other placed on the breast.

In case of pregnant workers wearing a lead apron, the abdomen dosemeter should be placed under the apron. The abdomen dosemeter should have the same characteristics as the whole body dosemeters, and should be read monthly by an approved dosimetric service.

The abdomen dosemeter should be adequately identified (codes, labels, etc.) to be distinguished from the other dosemeters used to determine whole body doses. Doses to the abdomen should be registered independently from the whole body doses.

It is important to point out, as stated by ICRP-84, that the fetal dose is not directly comparable to the dose measured on a personal dosemeter placed on the abdomen of the pregnant worker. A personal dosemeter worn by diagnostic radiology workers may overestimate fetal dose by a factor of 10 or more. However, from a conservative point of view, and following guidance from ICRP-60 it will be considered that a practical limit of 2 mSv for the equivalent-dose to the surface of the abdomen is equivalent to a fetal dose limit of 1 mSv.

During the remainder of the pregnancy, after its declaration, the radiation protection officer will supervise the doses registered by the abdomen dosemeter of the pregnant worker in order to verify that the corresponding limit is not exceeded. In the case that this value was exceeded, it would be taken the same technical and administrative actions as if a legal dose limit would have been exceeded.

5.2 Internal dosimetry

Individual monitoring for intakes of radioactive material is usually much more difficult and it presents important uncertainties. Assessment of doses to the fetus, due to intakes by the pregnant exposed worker, would need to be derived from models of processes like:

- Direct activity transfer to the embryo and fetus from maternal blood.
- Transfer of activity through maternal blood and placenta after deposition in the tissues of the mother.
- Distribution and retention of activity in fetal tissues.
- Growth of the embryo/fetus.
- Fetal irradiation from the activity deposited in the placenta and maternal tissues.

This modelling is extremely complex and must be particularized for each phase of growth of the embryo/fetus. On the other hand, recent studies have concluded that intakes of certain isotopes of hydrogen, carbon, phosphor, sulphur, iodine, calcium and strontium would imply higher doses to the fetus than those received by the pregnant worker.

In this context, it is necessary to avoid any significant risk of radioactive intake by pregnant exposed workers. As soon as the working conditions would guarantee that the intake probability would be negligible, there will be no need to implement any systematic assessment of internal doses that could be received by fetuses due to intakes of pregnant workers.

However, if there would occur any incident implying internal contamination of a pregnant exposed worker, there are methods that allow estimating fetal doses with an acceptable uncertainty level, from the radiation protection point of view. Details of these calculations can be found in ICRP publication nº 88.

6. Conclusions

Perception of risk associated to a certain activity, by an individual or by the society as a whole, is strongly influenced by subjective factors, among which are those related with non usual or difficult to understand activities or the fact that it affects children or future generations, like is the case of ionizing radiation.

Spread of basic knowledge about this subject in a clear and comprehensible way, for the public as well as for the medical staff, is one of the tasks to be carried by groups working in the radiation protection field. This has been the goal of the document presented in this paper.

As a summary, the most important aspects to take into account when an exposed worker is pregnant are the following:

1.- Working conditions should be as such to make it unlikely that the dose to the fetus will exceed about 1 mSv during the remainder of the pregnancy. Practical application of this limit would correspond with a supplementary equivalent dose limit to the surface of the woman’s abdomen of 2 mSv (lower trunk).

2.- Dose threshold for deterministic effects to the fetus is in the range 100 - 200 mSv.

3.- Probability of childhood cancer induction due to an exposure of 1 mSv of the embryo/fetus is negligible and, in any case, much smaller than the probability of spontaneous cancer or due to any other cause.

4.- As soon as an exposed worker realizes she is pregnant, she must notify it to the radiation protection officer or the physician in charge of the medical surveillance of exposed workers.

5.- When a medical radiation worker is known to be pregnant there is no need of discontinuing in her job, it will be necessary to review carefully her exposure conditions to be adequate in each particular case.

6.- It should be paid special attention to information and education in this subject of exposed female workers as well as gynaecologists, obstetricians, and medical professionals in charge of the medical surveillance of exposed workers.

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Annexe I. Declaration of Pregnancy

This is to inform you that I am currently pregnant, in order to guarantee that the additional protection measures, foreseen in the corresponding regulations, are applied

Name:...…….....…….....

National Identification Document: .....…….....

I am currently working in the following area …….....…….....

I am _____ weeks pregnant. My expected delivery date is……..…….....

Date of the declaration.....…….....

Signature of the worker

Signature of the Radiation Protection Officer

Signature of the Physician in charge of the medical surveillance of exposed workers

Annexe II. Physician's Guide

Possible health risks to children of women who are exposed to radiation during pregnancy

- This information is intended to the gynaecologists, obstetricians, and medical professionals in charge of the medical surveillance of exposed workers.

- A pregnant exposed worker presents frequently anxiety situations due to lack of information about radiation risks she is exposed to, which can drive her to take wrong decisions from the professional point of view.

- The pregnant worker has the right to know the radiation risks, which she is exposed to, and the physician is the more adequate person to give her this kind of information in a rigorous and objective way and in a more comprehensive language.

Biological effects of ionizing radiation.

- The biological effects of ionizing radiation are classified in deterministic and probabilistic effects.

- Deterministic effects involve the malfunctioning or loss of function of tissues in organs due mainly to cell loss. These effects result from high dose exposures and for them there is a threshold. The severity of the resultant changes increases as the dose is increased. Examples of deterministic effects that may occur in the fetus/embryo are abortion, congenital malformation and mental retardation.

- Probabilistic effects appear to have no threshold and may occur after low radiation doses. As the dose is increased the frequency of such events increases. It is assumed that the double the dose the double the frequency of the effect. However the severity of the resultant changes is not expected to increase as the dose is increased. Cancer is an example of probabilistic effect of radiation.

- Deterministic effects are avoided in normal radiation protection procedures by limiting doses to below the threshold dose levels for these effects. Probabilistic effects can be reduced in frequency by lowering the dose as much as reasonably possible. Probabilistic effects induced by radiation are indistinguishable from those produced by natural causes or other factors.

Specific effects to be considered during the pregnancy.

- The effects of exposure to radiation on the fetus depend on the time of exposure relative to conception, the amount of absorbed dose and its distribution in time: a dose received distributed along a certain period of time is less harmful than received instantaneously.

- In relation to the period of gestation, it can be distinguished:

  Before implantation of the embryo:

  From data obtained from experimental animals it is estimated than doses in the range 100-200 mSv can induce about 1-2% of lethal effects in the embryo. At this early stage in pregnancy the effect of damage to the embryo is most likely to take the form of failure to implant or of an undetectable fetal death.

  Period of organogenesis:

  From the third until the eighth week malformations may be caused especially in the organs under development at time of exposure. The threshold dose to produce an increase of malformations in experimental animals has been about 500 mSv. It is assumed, from a conservative point of view, that threshold dose for humans would be in the range 100-200 mSv.

  Early fetal period:

  During the most sensitive period, 8-15 weeks after conception, the most important effect found is mental retardation of varying degree: from a IQ decrease up to severe mental retardation of cognitive functions. The threshold dose for severe mental retardation is about 120-200 mSv. For exposure during weeks 16-15,

mental retardation has been as well observed, but with much smaller risk. The threshold dose in this period is estimated to be about 500 mSv.

Mental retardation has not been observed in embryos exposed in the first two months after conception or after week 25.

Late fetal period:

During the last quarter in the pregnancy, incidence of malformations or mental retardation due to fetus exposure is not expected. However, probability of cancer induction including leukaemia, which are expressed during the first decade of life, can be increased.

Epidemiological studies allow assess a spontaneous incidence of childhood cancer, without radiation exposure above natural background, of about 2-3 per 1000. The most conservative estimations indicate that this incidence could increase about 0,15% for doses of 10 mSv. That means that there would be an increase of 1,5 children in every 1000 children exposed to a dose of 10 mSv during this period that would develop a fatal cancer at ages between 0 and 15 years.

From the above, it can be deduced:

- In order to any deterministic fetal effect after his mother exposure is produced, it is necessary that doses would exceed the threshold of 100-200 mSv. This dose is much higher than what can be received by a pregnant worker during the normal operation in diagnostic radiology, nuclear medicine or radiotherapy departments.

- The increment of probabilistic effects due to radiation exposure for doses about 1 mSv is much smaller than the spontaneous incidence rate of fatal childhood cancers that is about 2-3 per 1000.

As a summary**:**

- The fetal dose limit of 1 mSv for the remainder of the pregnancy after it is declared, established in the spanish legislation, provide an adequate protection to the fetus and in general higher than in other working activities accepted by the society, since it has been established based in ethical considerations: since the unborn child has not made any decision and he does not receive any benefit from it.

- The application of this fetal dose limit in practice, corresponds to a supplementary equivalent dose limit to the surface of the woman’s abdomen (lower trunk) of 2 mSv for the remainder of the pregnancy.

- It must be kept in mind that the annual mean value of effective dose due to natural sources of radiation, in Spain, is 2,4 mSv and there are no differences among the effects that may be produced by a same dose of radiation, depending on its origin: natural or artificial. So, a pregnant worker that would change to a position where there would be no radiation exposure, would receive a mean value of effective dose of 1,8 mSv, due to natural radiation, during the 9 months of pregnancy.

Annexe III. Pregnant Worker's Guide

Possible health risks to children of women who are exposed to radiation during pregnancy

If you are a female worker exposed to ionizing radiation, you must know:

- The biological effects of ionizing radiation are classified in deterministic and probabilistic effects.

- Deterministic effects involve the malfunctioning or loss of function of tissues in organs due mainly to cell loss. These effects result from high dose exposures and for them there is a threshold. The severity of the resultant changes increases as the dose is increased. Examples of deterministic effects that may occur in the fetus/embryo are abortion, congenital malformation and mental retardation.

- Probabilistic effects appear to have no threshold and may occur after low radiation doses. As the dose is increased the frequency of such events increases. It is assumed that for a double value of the dose the frequency of the effect will be double. However the severity of the resultant changes is not expected to increase as the dose is increased. Cancer is an example of probabilistic effect of radiation.

- Deterministic effects are avoided in normal radiation protection procedures by limiting doses to below the threshold dose levels for these effects. Probabilistic effects can be reduced in frequency by lowering the dose as much as reasonably possible. Probabilistic effects induced by radiation are indistinguishable from those produced by natural causes or other factors.

- In Spain, as well as in the other countries of the European Union, the dose limit to the fetus, due to his mother's work exposed to ionizing radiation, is 1 mSv, after the pregnancy is declared. The application of this limit in practice, corresponds to an equivalent-dose limit to the surface of the woman's abdomen (lower trunk) of 2 mSv for the remainder of the pregnancy.

- The annual mean value of effective dose due to natural sources of radiation is 2,4 mSv and there are no differences among the effects that may be produced by a same dose of radiation, depending on its origin: natural or artificial.

- So, a pregnant worker that would change to a position where there would be no radiation exposure, would receive a mean value of effective dose of 1,8 mSv, due to natural radiation, during the 9 months of pregnancy.

- The fetal dose limit of 1 mSv, due to the working conditions of the pregnant worker, after the declaration of pregnancy, represents a non-significant increment of the dose that the pregnant woman would receive in the case of discontinuing in her job. This limit has been established based in ethical considerations: since the mother may have chosen to be a radiation worker, the unborn child has not made such a decision, so he must be considered as a member of the public.

- From the radiobiological point of view, this limit is much lower than the dose values required to provoke deterministic effects after prenatal exposure. Abortion, congenital malformations, IQ decrease and severe mental retardation do not appear with doses less than about 100-200 mSv.

- Spontaneous rate of abortions is about 300 per 1000, congenital malformation rate observed in general population is about 60 per 1000. Epidemiological studies allow assess a spontaneous incidence of childhood cancer, without radiation exposure above natural background, of about 2-3 per 1000.

- In order to adequately protect the fetus it is necessary that the pregnant worker declare her pregnancy to the head of the radioactive installation, as soon as she realizes she is pregnant. The employer and the radiation safety officer should decide the best protection methods for accomplishing the goal of the doses to the fetus being kept to a minimum and, in any case, lower than 1 mSv during the remainder of the pregnancy. In this way, mother's work would not represent any additional risk to her child.

- The radiation safety officer will review her working conditions in order to that the employment should be of a type that does not carry a significant probability of high accidental doses and intakes.

- The pregnant employee will be assigned an additional dosemeter to estimate doses to the abdomen.

- Finally, it is interesting to point out that, if her working conditions are such that doses to the fetus can keep lower than 1 mSv, a pregnant worker can feel safe enough in her position during the rest of her pregnancy.

Summary:

*If you are an exposed employee and you are pregnant **REMEMBER**:*

- *YOU MUST NOTIFY YOUR PREGNANCY TO THE EMPLOYER.*

- *YOU MUST FOLLOW THE GUIDANCES ON RADIATION PROTECTION.*

- *YOU MUST WEAR AN INDIVIDUAL DOSEMETER ON YOUR ABDOMEN.*