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Uranium mining and the environment: Are “baselines” useful?

For the quick reader: directly to Conclusions and Recommendations

To the French version Recommendations and Conclusions

Volatile prices in the uranium world market, rumours and numerous reports about expected shortages in mined uranium as well as acquisition of companies, operators and sites currently drive many new uranium mining projects, especially in Africa.

Before a mining project gets the go-ahead by the regulators, an environmental impact study (EIS) is prepared. This is the case in the well-regulated United States, in less regulated Canada, and in dramatically under regulated Namibia. Not everywhere in the world, but in many civilised countries, though. Take it as a general rule, without only a few exemptions.

Part of the EIS is a baseline, as prepared by the applicator for the mining project. In a number of cases of new uranium mining projects, it has been proposed to prepare “alternative baselines” on behalf of communities and NGOs. These baselines propose

- measuring gamma dose rates on the surface,
- measuring radon in the air,
- analysing groundwater.

It is also under discussion whether new sites should be epidemiologically inspected to be sure that no effects are missed.

This paper concentrates on the following questions:

- Before a mine is permitted: Can all environmental effects of a uranium mine be known before such a project starts?
- Before a mine starts operation: Is it useful to prepare an “alternative baseline” that is more comprehensive, reliable and independent from the operator’s baseline?
- During and after mine operation: Should there be alternative methods to detect possible hidden effects on health and safety?

This paper is meant for people that are not familiar with uranium mining projects in detail and for community members that want to know what to do (first) and, because resources are always scarce, on what to concentrate on.

Environmental effects of uranium mining

Many past and current experiences in a large number of countries show that uranium mining has enormous consequences for the environment and still is a heavily polluting undertaking. Large areas have to be mined, large amounts of materials have to be handled, chemically treated and later on disposed. At uranium mines materials are extracted or exposed that remain radioactive forever. At uranium mills the highest uranium content material are mixed with chemicals in a separation process. These materials often contain toxic constituents that were already part of the natural ore or deposit, but after excavation and treatment are easily accessible for water that is allowed to seep through the large waste piles and so can cause groundwater contamination.

All the handled materials have to be safely encapsulated over extremely long times to prevent releases because they pose risks for the health of people that

- breathe air mixed with radioactive radon gas and its decay products that are allowed to escape from the disposed material, wherein radium continuously produces the radioactive noble gas radon,
- come into close or direct contact with the material or use it for building purposes,
- drink water that is contaminated with radioactive or toxic constituents, because it was pumped from groundwater downstream a pile or taken from a flooded mine opening or
- eat plant or foods that have absorbed, eaten or been cooked with water that contain contaminants releases form handled materials.

All these impacts are well known among experts, their quantitative extend is assessable or calculable within an acceptable range of uncertainties, and their health consequences are also well understood. Uncertain and a source of discussion are not any unknown, suspected or hidden health or environmental effects but the extent to which these hazards have to be controlled, limited or completely avoided. The question is on how strict and consequent rules should be made and applied, and, in some cases, on who should be made (technically and financially) responsible to reclaim the area to avoid or reduce those hazards and consequences.

Two different views

Currently a rapidly growing portion of new uranium mining projects are in Africa. Several projects are in States that so far had no experience with the specific health and environmental effects of uranium mining. So these projects reach the attention of many people that so far were not very familiar with the environmental impacts of mining in general and uranium mining in particular. The assumption among non-experts then is that low or lacking environmental standards and high impacts might have to do with

- bad governance in developing countries,
- the economic (and perhaps political?) power of large mining companies,
- uninformed and/or powerless local people that are affected and are unable to voice their concerns, or
- even a mix between bribery and faineance.

Experts, on the other hand, are familiar with the endless worldwide list of former and currently active mines that lack a sound environmental management and restoration plan and practice. They know that poor environmental standards in that industry are a worldwide phenomenon and the above named suspected reasons might be of some site-specific relevance, but don't explain why so many sites in so many different countries with widely differing environmental standards are all of the same poor quality. Experts e.g. know that the poor restoration of former sites in France is in fact nearly identical to poorly managed sites in Africa, in that case a more company-specific phenomenon.

The two different views of non-experts and experts lead to a very different approach and to serious misunderstandings. This paper tries to make clear from an expert's view what might cause errors and names the risks associated with a too-narrow view of the problem.

The "baseline" approach in general

A baseline is a more or less comprehensive analysis of the pre-mining status of a site and its environmental properties. Everybody agrees that this is necessary:

- The mining company is required to prepare this and to include this as part of its license or permit application and the associated Environmental Impact Study (EIS) related to that proposed activity.
- The national regulation and applicable state regulation requires this as part of the permit process.
- Everybody wants to know which endangered species are at risk, once the project will go on, if the groundwater will still be available and potable, etc.

- Detailed knowledge of baseline conditions is needed to define pre-mining conditions as part of efforts to monitor effects of uranium mining activities.
- Detailed knowledge of baseline conditions are needed as to pre-mining conditions as part of efforts to measure effectiveness of reclamation and restoration efforts.

Within the formal permit process, the baseline is meant to identify, measure, study, understand and evaluate what the environmental consequences of a project will be. The baseline is the pre-mining status. If and when operations begin, the changes by the project have to be named, quantified (whenever possible), and evaluated in order that unacceptable changes to be avoided, reduced or compensated. The interest of the mining company in this stage is to demonstrate that only acceptable changes will happen, if the project will be given the go-ahead. The interest of local people is that

- all potentially affected properties (people, environment, etc.) are known and understood and the effects are evaluated,
- all effects are quantified correct or, if uncertainties are relevant, their maximum extent is known,
- effects are considered within their specific distance, so that no effect is missed because of a limited scope,
- enough of a financial guarantee is established to assure that all needed remediation and reclamation work will be completed if the operator is unable to perform all tasks effectively,
- longer term effects are not forgotten, e.g. the closure and long-term stabilisation of tailings ponds has not been forgotten (“Oops, aaah, we plan to do that later on, probably, perhaps!”).

It should be noted that preparing a good baseline for a project is a challenging process. Among the numerous aspects to be measured and analysed are e.g. wind and groundwater speed and directions, air, surface water and groundwater quality in a broad sense, soil, flora and fauna analysis, including current (and historically available) amount of naturally occurring uranium, uranium decay products, toxic heavy metals and general chemical characteristics of water, air, soil flora and fauna, among other attributes etc.

The quantification and evaluation of project-specific changes and effects is in some cases based on baseline data, e.g. the dose calculation for radon, uranium and radium has to be based on reliable data for wind speed and directions, otherwise conservative assumptions must be made leading to maximum doses in any one direction from the source. In some cases the baseline can have a relevant influence on the evaluation result. High baseline condition raise the questions, “if the baseline for surface or groundwater quality says that the water already has high concentrations of sulphate or uranium (high “natural background”), and the project will cause a small increase, can the project still go on or are reductions in sulphate and uranium emissions via groundwater necessary and technically feasible? Is the water with high baseline water quality currently used for - or possible to use for - as drinking or agricultural water or is ground water protected as an environmental resource by itself? Does contaminated groundwater affect the water supply of the nearby community?

What would be the role of the baseline for groundwater in this evaluation process? This baseline should not affect the operator’s requirement to contain its toxic materials and to reduce its releases to the groundwater. If a groundwater resource is not used for drinking water purposes today, why assume that this will not be the case for the next 1,000 years?

In a growing number of cases the baseline has an additional role: As measuring points for regulations that requires that post-mining restoration efforts have to reach pre-mining water quality or re-establish sustainable post-mining conditions on damaged lands. Restoration is sometimes the case for groundwater following in-situ-leaching and where releases from waste piles contaminate surround surface or ground water. The baseline in these cases set clear quality targets (concentration “after” is equal or less than “before”). Unfortunately, all efforts to reach that pre-mining baseline targets so far failed due to challenges presented by effects of hydro chemical in situ leaching process on affected ore zones. And: similar target settings for other cases, - like radon emissions, toxic groundwater constituents, population density of endangered species, or overall appearance of the landscape -, will not work either.

So in all cases the baseline has a role when evaluating the potential impact of a project, but has no significant role in setting targets for a post-mining long-term restoration.

Errors and the quality of Environmental Impact Studies

Whenever an EIS is published, all interested people can study this. It can be shown in many cases that all have serious errors. Among those are simple errors in calculations, false assumptions, missing or false descriptions of technical processes, missed endangered species, too short-sighted focus on operational effects, forgotten waste issues, dose calculations for 20 km distance and not for a person on the fence of the facility, and many more weaknesses. I even remember an EIS that stated that Radon doesn't contribute to doses because it has too short of a half life time, so it doesn't even count.

So, the first thing to do is to go through the several 100 page long document, and to point to errors and weaknesses. If the responsible governmental agency doesn't do this, the correction and evaluation is your part.

And don't forget: you are the local expert that knows all about wildlife at the site. Not the Canadian that comes in twice and only sees what runs around in these five days of the whole year.

The pre-mining status of the environment (baseline) of the mining company should include all relevant aspects, at least those that will be directly or indirectly affected by the mining project. Before an EIS is performed, check its completeness by going through the list of aspects to be studied and add the aspects that you see as relevant. In the draft EIS, to be published before the public hearing process takes place, check if all aspects were studied in a correct manner, to the necessary detail and are complete. Bring your view of the draft to the attention of the responsible governmental agency, either oral in the hearings or in a written form. In the final EIS, make sure that all aspects are treated correct and that all your additional points are either included or rational arguments are provided on why this or that was not included.

Expectations on "alternative baselines"

After having described the baseline and its role in the Environmental Impact Assessment (EIA) process, some other ideas currently are under consideration as an alternative. The idea behind those "alternative baselines" is basically very simple:

1. To prepare a balance sheet on the pre-mining environmental state by an independent monitoring,
2. to let the mine operator more or less do what he wants (alternative baselines do not intend to avoid, reduce or compensate impacts, just to detect and pin-

point them),

3. during operation to follow the operator's pollution history by independent monitoring methods,
4. to prepare an independent post-mining balance sheet, and
5. to blame the operator, after he ceases its operation, on what effects his operational phase had and what mess he has left and what damages he will do in the future.

As in stage 5 many of the mining companies can't be blamed because they aren't existing any more (are not in the country any more, are closed, are sold, are bankrupt, etc.) the whole chain is more theoretical. So, see this scheme more as a help to be more conscious about your own expectations on baselines.

The "independent" in some of the above cases means that the operator is either not willing to monitor or not willing to disclose his results, so someone else has to do this instead. As governmental agencies are not seen as neutral enough, a neutral entity is searched for to do this to make sure this will be done in a correct and transparent way.

"Independent" can also mean that the operator is expected to falsify monitoring results to hide its bad environmental record. The trust in the operator's monitoring is small, so somebody else should do this. Other driving expectations behind alternative baselines are e.g.:

- before a mining project goes ahead nobody can know what the environmental effects will be, so measuring can point to unknown effects,
- the models applied in the pre-mining stage to evaluate the environmental consequences (radon dose model, groundwater flow and contamination model, etc.) are not reliable and can be easily manipulated, so measuring can verify the models used,
- the mine operator will hide its negative pollution monitoring results behind the well-known sentence "that's all natural baseline",
- probably there are some hidden health effects, that are currently not known and understood in science, and might lead to hidden health and environmental damages that nobody had expected before.

The latter is a rather tricky expectation, because hidden effects principally cannot be revealed by scientifically sound methods, as science currently doesn't know about it.

Many of the above expectations have a certain probability, for some of them historic and current examples can be cited, but many of these are simply uninformed expectations.

Problems of "alternative baselines"

a) Reliable enough "alternative baseline"

As shown above, the effective comprehensive baseline for the EIA requires very extensive and expense multi-year efforts. Due to the cost of comprehensive baseline data compilation, it is likely that the alternative baseline will be less thorough or extensive than that prepared on behalf the operator. If that is the case, you'll have a serious problem. Bad independent's science against comprehensive operator's science? Easy to say who looses the argument, and its reputation. Don't try to base your critique of the EIS on data that was collected with a lower quality and intensity as demonstrated in the EIS. If you would do so, the least consequence would be not to be taken for very serious by the mining company and by the regulator.

b) Alternative radiation baselines

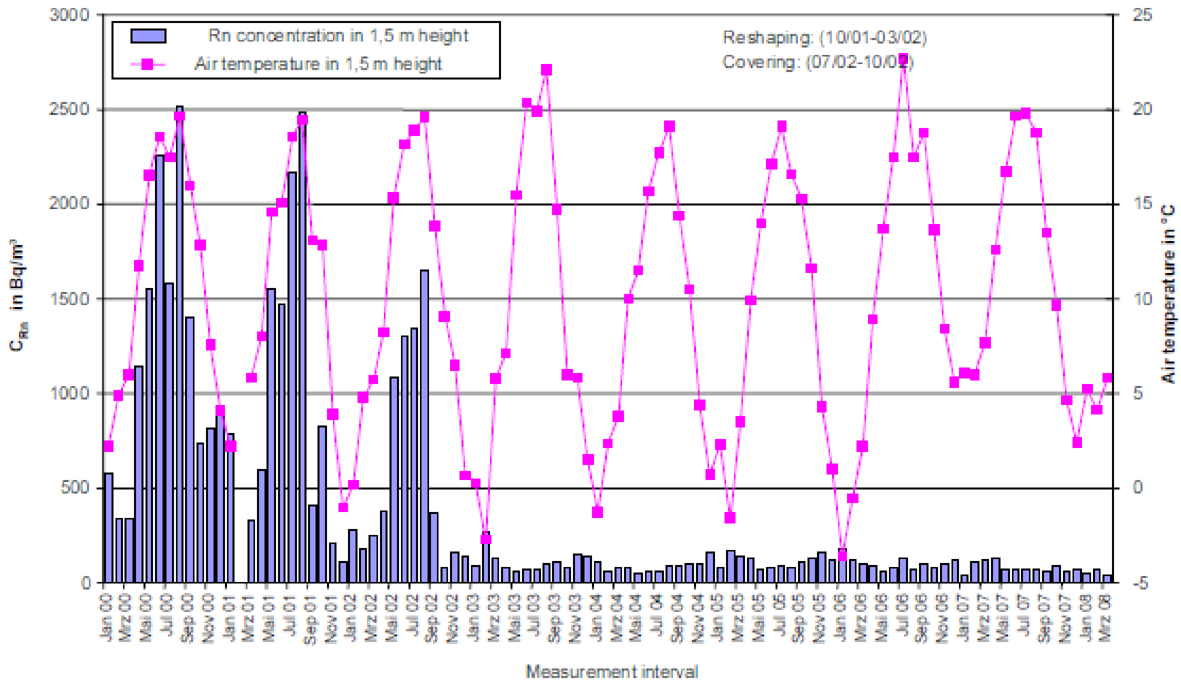
Radiation baselines within the EIS usually require measuring the most significant pathways and the properties that are relevant for dose modelling. That means in particular:

- radon background,
- alpha-content of dust particles of inhalable size as background,
- wind speed- and direction-distribution as parameter for dose modelling,
- ground- and drinking-water (Uranium, Thorium, Radium and Lead-210).

All those pathways require modelling to evaluate the changes that the mine will cause later on during its operation and after closure. Note that an evaluation of those models by environmental monitoring is a very complex task: it is impossible to do this in a scientifically sound way without enormous resources. And it takes years and years to come to be sure. Something you shouldn't expect to be your or your community's task. And: that effort doesn't reduce emissions, doesn't enforce radon covers, doesn't protect groundwater, etc. It is just science. Wrong focus, so to say.

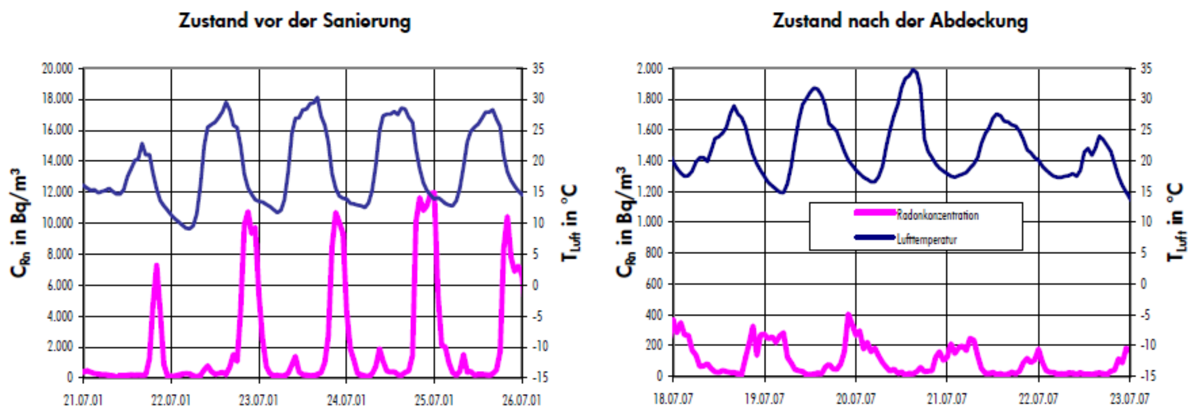
Radon measurements: don't do it the wrong way and they laugh at you!

Measuring the radon background is a very difficult task. The following example provides measured data from an area affected by a tailings pile in East Germany, later on reshaped and covered. Frequency of the measurements was 2 months.



What can be seen easily is that the radon concentration (blue bars) is strongly depending from the air temperature (red curve)[1]. That is the case without (left) and with (right) a cover, but the variation with a cover is much smaller and less relevant.

Need more examples to understand? The following example stems from a house nearby a waste rock pile in East Germany, the measurements were taken over five days and were continuously recorded. So, one can even see the day-/night-variations in temperature and radon concentration. Again, left is without cover, right is with an installed cover.



In the left case, without cover, the measured results are between 10 Bq/m³ and

[1] Note that 1,000 Bq/m³ is equivalent to a dose of 6.4 mSv/a, clearly above acceptable doses.

12,000 Bq/l, in the right case[2] between 5 Bq/m³ and 400 Bq/m³. The left case clearly exceeds the acceptable radiation protection limits, the average in the right case might be within or around that limit. No matter what might be the “natural background” in the left case, exceeding the limit can in no case be attributed to natural background, no matter if the baseline was measured by the operator, by alternative institutions or was not measured at all.

So measuring radon only over a short period or without registering wind direction and speed as well as air temperature and air pressure is only information with a low quality, no reliable statements can be drawn from that. All in all, the small-scale version of measurements then is rather useless.

By the way: radon concentrations in those cases can well be modelled. Modelled and measured results fit rather well.

Alternative monitoring of radon concentrations prior to and during the operational phase of a mine project is of limited additional information, if not done in an extensive way and on a sound scientific basis. Better make sure that the operator monitors this, that measuring points are placed in correct locations, that he publishes its data regularly in standardised reports, and that measuring equipment he uses are best-available-technology and procedures he follows are quality-controlled. Additionally make sure that the responsible regulatory agencies are following their task in controlling the operator’s monitoring.

Dose rate measurements: misleading at best!

Similar results can be expected from gamma dose measurements. In the pre-mining stage gamma doses give an idea on the uranium distribution in the ground. As any earthen materials, especially those with considerable moisture content, have a strong shielding effect the gamma dose measurements just “look” less than 50 cm deep below surface. Not a very deep look.

Uranium usually does not appear too surface-near due to oxidation, mobilisation and subsequent washout in the surface-near environment. But in some rare cases uranium reaches the surface, continuously sourced by diffusion from a larger uranium

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[2] Note that the Radon concentration scale on the right side is ten times enlarged!

deposit in deeper ground. These special anomalies can be detected by gamma dose measurements. What are these anomalies saying? Mining is good because it removes those extraordinary high dose rates on the surface?

What else do average dose rate results say on effects of mining? Nearly nothing. Either these 50 cm thick surfaces do not exist any more (if they are in the area of the open pit or will be underneath waste piles that are to be erected) or are not affected because they are outside the mining area. So what are they for?

The dose rates on surfaces after mining tell different stories:

- In the case of a tailings disposal area or on top of waste rock piles: are those covered at all? Are those covers thicker than 50 cm? Are they still intact or degraded?
- Outside those disposal areas: were materials lost during handling and transport? Has material been used for other purposes, like building roads and houses?

All this can be checked without knowing something on the state before mining. The thickness of covers (outside France) is an engineered design, considering things like

- the acceptable seepage through the cover and the waste cell,
- the degradation through erosion by wind, rain, storm and snow over the coming 1,000 years,
- the differential settlement of different waste materials disposed,
- the expected damages to covers by plants and the activity of burrowing animals,
- etc.

Waste rock, and even more tailings disposal areas, if not covered, show elevated to extremely high dose rates. With a minimum cover, let's say of an Areva design with e.g. 30 cm, the measured dose rate is about or slightly above background (shielding effect). If some rabbits dig through the cover material, you will find those wholes with your dose rate meter, but you'll see them easily without your digital device. With a more sophisticated cover, US design of let's say 250 cm thickness, it is also around background. So what do these measurements say then? Not much, at least not on the appropriateness and reliability of the installed cover.

A low-quality and a high-quality cover do not differ in the dose rates, they differ in their longevity. The quality is measurable by comparing the freshly installed cover with its virtual equivalent that has seen 1,000 years of "normal" and "extraordinary" rainfall, snow, long dry periods in 1,000 different summers, typical site-specific earth-quakes and hurricanes that realistically appear over that time period, several hundred generations of burrowing animals, water loss in the waste cell and settling of the underlying waste material, and so on, and so on. The gamma dose reduction factor is not among these quality criteria because any good cover that withstands the above named effects over the design time provides enough shielding, no matter how concentrated the uranium ore once was.

Measuring gamma doses on top of tailings disposals can easily be done, but says nothing about the quality and longevity of the disposal cell. At least not earlier than 1,000 years after installation! So why do measurements a few years after installation? It distracts your attention from the real things to be looking for. So better ignore the dose rate and tell the mining company that you want the design-criteria and -plans and the quality assurance measures for the construction of the cover. That will tell you more about if they've done a good job than several hundreds of dose rate measuring results.

And don't forget: the dose rate is not among the most relevant pathways for exposure from uranium mines. So don't waste your time with this and concentrate on the things that really count.

Make sure that the operator has a Waste Management Plan that, during operational time, makes sure that the tailings and the waste rock are disposed in a safe manner (dam safety, etc.) and that radon, dust and liquid emissions are carefully minimised. Also make sure that the operator has, from the beginning of its operations on, a long-term plan on the final disposal of its waste materials and that his operational management is in good accordance with its long-term plans for the encapsulation of its waste. And, additionally, make sure with an approved and regularly updated funding scheme that the long-term encapsulation can technically and financially be managed even in the case that the operator fails to do this.

Epidemiological baselines

Even more problematic are epidemiologic baselines. Epidemiologic baselines try to measure the health status before mining, in order to detect health effects during and after mining. Popular things to measure are

- cancer rates,
- birth defect rates, and

- male/female birth ratios.

General: epidemiologic methods always require very large populations or very long timescales to be reliable. Depending on the specific conditions, measurements require more than 1,000 or 10,000 persons to reduce statistical random noise. Otherwise the results might be – just random. So what if the number of affected persons in the vicinity of a mine (let's say within 1,000 m distance) is much smaller? Your effort will not pay out, because you will not be able to show that the measured effect is above statistical random noise.

Radon and (lung) cancer rates

The connection between radon exposure and lung cancer has been studied on miners since the middle of the 19th century in the Czech Republic. Those miners were exposed to very high radon concentrations over very long times, so the effect was several orders of magnitude larger than would be expected outdoors in some distance to a mine. Even at these higher radon concentrations the systematic examination of thousands of mine workers was necessary to yield a statistically reliable connection between exposure data and lung cancer rate.

Indoor exposure to radon and the resulting elevated lung cancer rate was studied with more than 10,000 persons in Sweden. For these persons their individual exposure data over their whole lifetime was estimated e.g. based on measurements at their current and previous homes. The result is above statistical random, but not very well above random.

In order to improve the epidemiology two or more of those studies are pooled, so that the result is clearer. So don't try to detect something among 100 persons for which others needed 10,000 or more miners or individual exposure histories.

The quantitative risk of radon exposure for deadly lung cancer

An exposure to 1 mSv/a(eff.) radon over 40 years corresponds to an added exposure of 40 mSv(eff.). The rate of deadly health damages, as determined by the Internatio-nal Commission on Radiation Protection (ICRP), is 0.05 /Sv(eff.) or 0.00005 /mSv (eff.). So the added risk associated with that exposure to 40 mSv is 0.002. That means that among 500 persons exposed to that level there will be one person that statistically will develop lung cancer and will die from that exposure.

Of 500 persons, that were not exposed to that radon source over 40 years, around 15 will die from lung cancer, if the average lung cancer rates in the US are taken as reference. Even the best epidemiologic analysis will not be able to separate the additional one deadly cancer among the other 15 that were not caused by the emitted radon from the source.

To not be misunderstood: even if you can’t proof with epidemiological methods that there is an additional cancer case, that means that there is an additional person killed. And it is not only statistically killed, it’s real, even if you can’t put a name tag to that person and you can’t see it in your epidemiological statistic. Epidemiological methods are just too fuzzy and inaccurate to proof that.

Even if one assumes that ICRP underestimates the risk for lung cancer: only an underestimation by a factor of 15 would double the expected cases of lung cancer among those 500 exposed persons. That would be an effect on the minimum level, just to be detected with epidemiology and statistic. But: the lung cancer rate from radon among miners and among the population is a well-known and intensively studied case, so the factor of 15 would have been found in those cases, too. It didn’t show up.

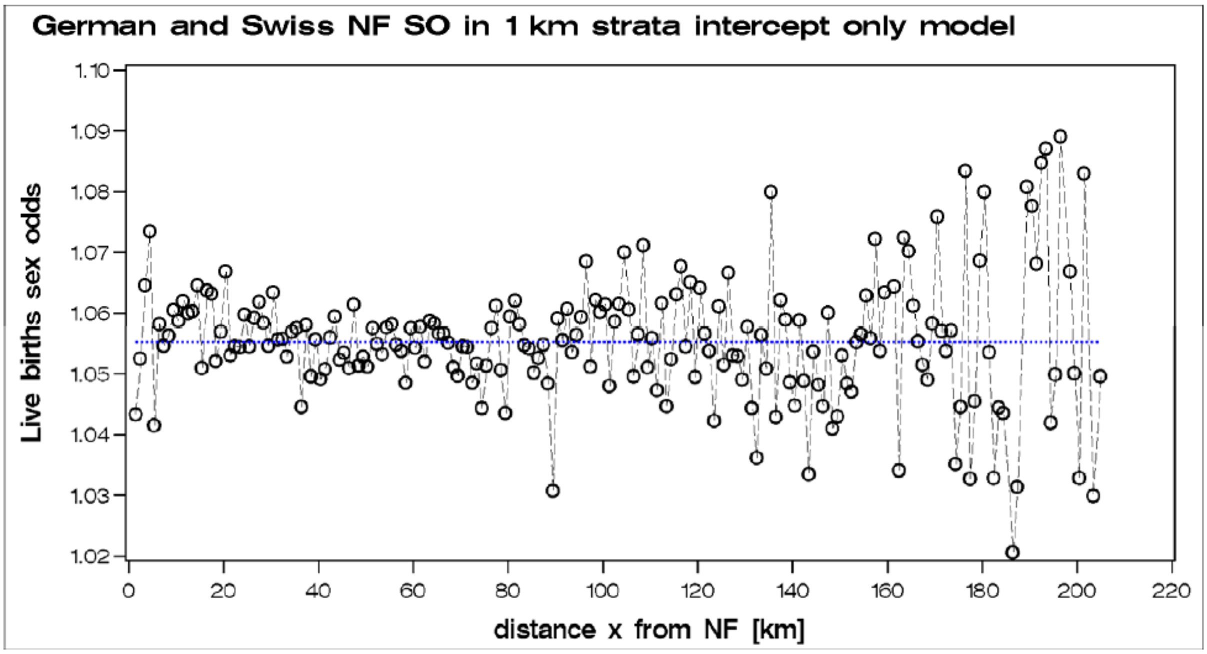
Epidemiological “proof” alone has nothing to do with science

One thing is to measure something with epidemiologic methods in more or less accuracy. Another thing are the mechanisms and pathways how those damages in detail are caused. The case for lung cancer from radon is very well known (see above), so the pure statistic has an added well-studied cause-effect-connection: alpha-decaying radio nuclides bombard lung cells with high-energy particles, with a risk for causing abnormal cell behaviour. The connection is well understood, the dose-to-risk relations are consequent and quantified.

For most of the other epidemiological study objects the mechanisms are only known in very general terms and have not been studied in that detail. So it might well be that the epidemiologically “measured” effect has other, very different causes. As an example for the small contribution of epidemiological methods to detect cause-effect-relationships the study on sex-odds vs. distance from nuclear power plants will be discussed in more detail.

German epidemiologists have counted the birth sex in relation to the distance to nuclear power plants in Germany and Switzerland. This is what they have found (see graph).

The sex ratio is between 1.02 and 1.09. That means: Among 1,000 children born are between 510 and 545 male, 490 to 455 female. Each single birth among those 1,000 causes the ratio to rise/decrease the sex ratio by 1.002, so the statistical requirement for detecting significant differences should be at least 1,000 births.



With the small birth rate in Germany (8.21/1,000) and Switzerland (9.69/1,000) 1,000 births requires a minimum population of approx. 120,000 persons. With the larger birth rate e.g. in Mali (46.09/1,000) at least 22,000 persons are required to yield any statistically significant numbers. With a smaller population you end up in random and in pure believe. If the community affected by a mining project is much smaller than this: forget this epidemiological method, you will not be able to detect an effect.

To detect a dose-to-sex-ratio relationship the doses for each person among these populations should be known within a minimum reliability, like done in the indoor radon study described above. Instead of studying and calculating doses, the authors of the above cited study chose to avoid this and suggest distances from nuclear facilities as an indicator for the doses. But: the individual dose strongly depends from such factors like wind directions, the diet, the sources for food and water, and many more. The distance between a facility and the dose from its emissions for each individual is all but linear. So, better forget any statistic beyond some 10 km to a source, because the individual doses are too fuzzy and too small to cause a detectable effect.

If one searches for differences in that ratio within 10 km distance, the population for the statistic is rather small. Among the most populated areas within 10 km distance to an NPP is Biblis/Germany, with approximately 25,000 persons living in that circle.

Given the small German birth-rate, this population is much too small to detect an epidemiological effect, because only one of the 205 statistical births per year causes a statistical deviation of the ratio in the order of 1.01, so you will not be able to detect an increase in the sex ratio from 1.055 (average) to 1.075 (increased ratio in 10 km distance) with some statistical reliability. The authors don't even discuss this statistical stray effect in their data within 10 km distance.
The largest differences in the sex ratio in the above cited study are beyond a distance of 150 km. The dose in 150 km distance from the source is extremely small. From what causes do these swings result from? The authors don't even try to determine or discuss the causes for this effect in their statistic in respect to the sex ratio. As doses from emissions in that distance are too small to cause a measurable effect, are other effects than emissions causing those large swings? Many questions that currently remain unanswered.
If compared to the relatively well-known dose-effect of radon and lung cancer, the epidemiology on sex ratios is at best in the beginning, still generating more questions than any certainties. The method

- is pure statistic, with no clear dose-to-effect analysis,
- requires
  - large populations with known doses from the source, these conditions are rarely found near uranium mines in remote areas, or
  - large enough doses that are normally not to be expected in the vicinity of uranium mining projects (doses larger than 1 mSv/a should simply not be permitted),
- is at best in a very early and highly speculative stage.

And what is the most relevant argument: epidemiological statistics do not really address the specific environmental consequences of a uranium project (doses to workers and the public in the vicinity by radon and dust, long term waste management, risks with dam stability, groundwater protection, devastation of landscapes, etc.). It is similar to an end-of-pipe method, only interested in balancing damages and not interested to avoid or reduce those consequences at source.

Epidemiology, if not done with a large number of exposed persons, with individual exposure data, and with enough resources, does not contribute to the understanding of health effects in the vicinity of uranium mines. The efforts better should be focussed on well-known health effects like the exposure to radon and dust, to groundwater contamination, the risk of dams, long-term exposure to tailings, etc.

Conclusions

“Independent alternative baselines”

- keep you from looking at the real things that count,
- require much efforts and resources, if they want to provide more and better information than the operator’s own monitoring,
- if not invested, the risk of fruitless discussions on appropriate monitoring methods is high and fails to address the more relevant environmental effects of uranium mining,
- if not based on a good understanding and on clear dose-effect relationships will end in the middle of nowhere, in speculation and in pure believe.

It is better to

- care about the real effects of a uranium mining project,
- increase the own and the public understanding of all risks and consequences associated with such projects and to quantify those,
- focus on the very well known risks and consequences, so there is no need to search for any hidden and unknown effects here, and to
- contribute to an informed control over operator’s and regulator’s handling of the risks and environmental effects associated with uranium mining.

So, better say good-bye to the idea of balancing meaningless “before” and “after” data, it is only balancing damages more correct instead of avoiding and reducing those. And so more care about the operator’s waste management concept, its radon dose calculation, its monitoring concept for air and groundwater, its financial funding of long-term liabilities, and some other things.

Enough to do here, no need to speculate around.

Recommendations:

Recommendation 1:

The pre-mining status of the environment (baseline) of the mining company should include all relevant aspects, at least those that will be directly or indirectly affected by the mining project. Before an EIS is performed, check its completeness by going through the list of aspects to be studied and add the aspects that you see as relevant. In the draft EIS, to be published before the public hearing process takes place, check if all aspects were studied in a correct manner, to the necessary detail and are complete. Bring your view of the draft to the attention of the responsible governmental agency, either oral in the hearings or in a written form. In the final EIS, make sure that all aspects are treated correct and that all your additional points are either included or rational arguments are provided on why this or that was not included.

Recommendation 2:

Alternative monitoring of radon concentrations prior to and during the operational phase of a mine project is of limited additional information, if not done in an extensive way and on a sound scientific basis. Better make sure that the operator monitors this, that measuring points are placed in correct locations, that he publishes its data regularly in standardised reports, and that measuring equipment he uses are best-available-technology and procedures he follows are quality-controlled. Additionally make sure that the responsible regulatory agencies are following their task in controlling the operator's monitoring.

Recommendation 3:

Make sure that the operator has a Waste Management Plan that, during operational time, makes sure that the tailings and the waste rock are disposed in a safe manner (dam safety, etc.) and that radon, dust and liquid emissions are carefully minimised. Also make sure that the operator has, from the beginning of its operations on, a long-term plan on the final disposal of its waste materials and that his operational management is in good accordance with its long-term plans for the encapsulation of its waste. And, additionally, make sure with an approved and regularly updated funding scheme that the long-term encapsulation can technically and financially be managed even in the case that the operator fails to do this.

Recommendation 4:

Epidemiology, if not done with a large number of exposed persons, with individual exposure data, and with enough resources, does not contribute to the understanding of health effects in the vicinity of uranium mines. The efforts better should be focussed on well-known health effects like the exposure to radon and dust, to groundwater contamination, the risk of dams, long-term exposure to tailings, etc.

French translations:

Recommandation 1

L'état des lieux avant l'exploitation minière (baseline) devrait inclure tous les aspects concernés, au moins ceux qui seront directement ou indirectement affectés par le projet d'exploitation. Avant qu'une EIE (Étude d'impact environnemental) soit menée, il faut vérifier si elle est complète en parcourant la liste des aspects qui seront étudiés et ajouter les points que vous jugez nécessaires. Dans le premier jet d'EIE qui sera publié avant les consultations publiques, il faut vérifier que tous les aspects ont été étudiés de manière correcte, de façon aussi profonde que nécessaire et qu'ils sont complets. Portez vos opinions du premier jet à l'attention de l'agence gouvernementale concernée soit à l'oral lors des consultations, soit dans un document écrit. Dans l'EIE finale, veillez à vérifier que tous les aspects aient traités correctement et que les points supplémentaires que vous aviez suggérés y soient soit inclus soit qu'une justification de leur absence soit fournie.

Recommandation 2

Des mesures alternatives de concentration de radon avant et pendant la phase opérationnelle d'un projet de mine ne fournissent que des informations additionnelles limitées si elles ne sont pas réalisées de manière extensive et sur une base scientifique solide. Il est préférable de vérifier que l'exploitant veille à cette tâche, que les points de mesure soient situés correctement, qu'il publie les données de manière régulière sous forme de rapports standardisés, que les moyens de mesure utilisés soient les meilleurs disponibles sur le marché et que les procédures utilisées aient subi un contrôle de qualité. En plus de cela, il faut veiller à ce que les agences de régulation compétentes réalisent leur travail de contrôle des exécutions de l'opérateur.

Recommandation 3

Il faut vérifier que l'exploitant ait bien un Plan de gestion des Déchets qui, lors de la phase opérationnelle, assure que les déchets d'extraction (tailings) et les déchets rocheux soient confinés correctement (sûreté des barrages, etc.) et que le radon, les poussières et effluents soient minimisés avec précaution. Il faut aussi vérifier que l'exploitant dispose, dès le début d'exploitation, d'un plan de gestion au long terme

des matériaux inutilisés et que sa gestion des opérations est bien en accord avec ses plans au long-terme de confinement des déchets. De plus, il faut, grâce à un plan financier approuvé et régulièrement mis à jour, vérifier que le confinement au long terme est techniquement et financièrement réalisable même si l'exploitant faillit à le faire.

Recommandation 4

Les études épidémiologiques, si elles ne sont pas réalisées sur un nombre important de personnes exposées, disposant de données individuelles d'exposition et avec des ressources suffisantes ne contribuent pas à la compréhension des effets sur la santé des environs d'une mine d'uranium. Les efforts devraient se concentrer plus efficacement sur les effets sur la santé bien connus tels que l'exposition au radon, à la poussière et à l'eau souterraine contaminée, les risques des barrages, l'exposition au long terme aux déchets d'extraction, etc.

Conclusions

"États des lieux alternatifs"

- ils vous empêchent de traiter les choses les plus importantes
- des informations plus nombreuses et de meilleure qualité que celles de l'exploitant font appel à bien plus d'efforts et de ressources
- Si de tels moyens ne sont pas investis, le risque encouru est une discussion stérile sur les méthodes appropriées de mesures qui ne parviendrait pas à traiter des effets environnementaux réels de l'exploitation minière d'uranium.
- S'ils ne sont pas basés sur une compréhension correcte et des relations claires de dose à effet, ils ne mèneront à rien de plus qu'à des hypothèses spéculatives et à de pures croyances.

Il est plus approprié de:

- Se focaliser sur les effets réels d'un projet de mine d'uranium
- Améliorer la compréhension (la votre comme celle du public) de tous les risques et conséquences associés à de tels projets et les quantifier.
- Se concentrer sur les risques et conséquences bien connus : il n'est pas nécessaire ne rechercher quelque effet caché ou inconnu
- Contribuer à un contrôle informé de la gestion par l'exploitant et l'autorité de

régulation des risques et des effets environnementaux associés à l’exploitation minière d’uranium.

Il vaut donc mieux dire au revoir à l’idée de comparer « avant » et « après » qui a peu de sens : il s’agirait en effet seulement de comparer les dommages de manière plus correcte au lieu de les éviter ou de les diminuer. Il vaut mieux porter plus d’attention au concept de gestion des déchets de l’exploitant, à son calcul de dose de radon, à son concept de surveillance de l’air et des eaux souterraines, au financement de ses obligations à long-terme et encore à quelques autres choses.

(Translation: Ségolène Berthou)