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A Story Behind My PhD
by
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On 19-th of February 2001, in presence of the Dean of Silesian Technical University, a bunch of university professors, two guests from NRG, as well as several other guests, I had to stand up and, having roughly 20 minutes time, present the work that kept me busy for more than four years. After the presentation I had to answer several questions and remarks from the reviewers and from the audience. About half an hour later the Dean announced the verdict of University Council, which made me a doctor in physics.

More than ten years before, when I graduated from the Silesian Technical University in Poland, I didn't know how exactly my professional carrier should look like, but I knew that I wanted to devote my life to computer simulations of thermal-hydraulic and other phenomena important in nuclear safety analyses. My first job was at the Institute of Atomic Energy (IAE), in Świerk near Warsaw, in Poland. The year was 1989, and the first Polish Nuclear Power Plant (NPP) was being built near Żarnowiec, in the northern part of Poland, close to the seacoast. Construction works were near completion. A large pressure vessel of the WWER-440 reactor, designed in Soviet Union, was on its way to Poland. In IAE that meant a lot of analytical work. We used mainly RELAP 4 and RELAP5, computer codes created at Idaho National Laboratories.

In 1990 and 1991 an opposition against introducing a Soviet design NPP became very strong. People discovered that, after many years of communistic regime, they are finally free to speak. So they protested against low wages, bad health care, bad education system and, of course, against nuclear power. In middle 1991, being about 80% completed, the Żarnowiec NPP was closed down by a government decision.

In 1991 a conference was held in Cadarache, France, on fission product release experiments performed on the Phebus test facility. Since I had been doing some analytical work on the Phebus test, I was sent to the conference to present the results. There, during one lunch, I talked shortly to Johan Kanij, and I've learned that there was a place called The Netherlands, where the demand for analytical work exceeded the manpower available to do the job. Facing the Polish market, rapidly declining after the closure of Żarnowiec, I decided to explore this strange paradise, where nuclear power was still blooming and analytical work was appreciated. I followed the advice of Johan Kanij and sent my personal resume to KEMA. As a result, on the 1-st of March 1992 I became a KEMA employee.

For the first few years my work at KEMA was mainly related to severe accidents, and computer codes like STCP, MAAP, MELCOR. In 1994 the participation in PANDA experiments, in Switzerland, allowed me to return to the thermal-hydraulic issues. Since RELAP was not available at KEMA, I had an opportunity to get acquainted with the TRAC-family codes. Couple of years of work with TRAC-BF1 and fighting with bugs in the code, slowly convinced me that if I only had a chance I could do better than that. Making analyses with codes was a lot of fun, but to create a code of similar capabilities; that's where a real challenge was. I remember one discussion I had with Joost de Wolff in middle 90-ties. I said that I could create a code of similar capabilities as TRAC, but without all the damn bugs in it, if I only had two years time, to be fully spent on it. He said that I had significantly underestimated the effort that was needed. Looking back, I have to admit that he was absolutely right.

Meanwhile, the climate in the "nuclear paradise" had slowly changed. Closure of Dodewaard NPP was one of the milestones on the path leading the society against nuclear power. Another milestone was the elimination of the KEMA Nuclear unit. As a result we now call ourselves NRG, after joining forces with ECN Petten. In short, the alleged paradise had clearly changed, and the resemblance to the situation in Poland after closure of Żarnowiec became uncomfortably close. Seems like whenever I start working in some place, the whole industry soon goes down the drain.

The decreasing amount of work had its positive side; I could start seriously thinking about my doctoral thesis. I started working on it in the second half of 1996. The official opening was in February 1997, at the Faculty of Thermal Technology, in the Silesian Technical University. Initially the idea was to perform a review of the models applied in several computer codes, and prepare a "Library of Recommended Models". That was an easy task. For example, you had to review the codes to see how the thermal radiation was modelled. Do some test runs, compare results with some available data. See which model gives best results. Improve it a little here and there to make it even better, then code it as standalone segments (subroutines). Then you'd test the model for all possible and impossible parameter range and, when you're sure that it works perfectly and is free from any bugs, you'd finally add it to the Library.

I don't remember when exactly came the idea of integrating the models into a system code. I was at that time working closely with Wim Slegers. The discussions we had were slowly forming a shape of the task to be done. Altogether it took about two years to build the Library and to integrate it into something of a preliminary version of a system code. Integration was a really hard work. The models from the Library, perfectly tested, when put together simply didn't want to work. Calculations were slow, the solution would frequently fail due to numerical non-convergence. I remember in spring 1998 I was asked to perform some calculations with the new tool (meanwhile called SPECTRA). The calculation was very slow. I was disgusted. All that hard work and what do you get? Another code that doesn't work as it should. For a while I though of deleting all my files, and forgetting all about it. My wife said that she believed that I can make it fine. That helped me to keep going.

It took more than a year of hard work before SPECTRA finally evolved into something like a mature code. Another person who believed in successful finish was Wim Slegers. I think I owe it to him that I was allowed to keep working on SPECTRA throughout 1998 and 1999. In September 1999 Wim suddenly died of a heart attack. I was just starting to write the text of my doctoral dissertation. I dedicated the work to him, the only thing I could do to express my gratitude for his help and support.

In December 1999 SPECTRA was finally ready, although it still happens from time to time that I have to make some small improvements and additions to the code. In 2000 SPECTRA was used to perform a "blind" analysis of PANDA tests ISP-42 ("blind" means that the outcome of an experiment is predicted without knowing the measured results). A large

number of institutes from different countries, using different computer codes, participated in calculation of the PANDA tests. Having obtained one of the closest predictions, usefulness of SPECTRA was shown among internationally recognised codes, like RELAP, CATHARE, GOTHIC, ATHLET.

The doctoral thesis was finalised on February 19, 2001, in Silesian Technical University, the same university from which I obtained my Masters degree. With two persons from NRG, Gerard van Dijk and Rudie Heling, the audience was international; in spite of that fact the official language was Polish. An interpreter was provided for the Dutch participants.

After the event there was a little dinner to celebrate the finalisation of the work. After that my family and I went back home; my Dutch colleagues, being strong and not easily wearied, went out to drink a couple of beers and to see the town where I grew up, went to a kindergarten, and school, in other words where I spent my “Wonder Years”. Of course, in those years the Netherlands was for me just a place on the map, like for example Philippines; I never thought I would ever visit any of them. So far I’ve never been to Philippines, but who knows, maybe there is a highly developed nuclear industry there, that needs to be wrecked.