IEEE TC 5: High Power Electromagnetics (HPEM) Technical Committee

Minutes of Spokane In-Person Meeting
Wednesday, 3 August 2022 (Noon – 1:30 PM Pacific Daylight U.S. Time)

Confirmed Minutes

1) **Opening of the meeting and approval of the agenda – Bill Radasky, Chairman**

Chairman Dr. William (Bill) Radasky brought the meeting to order at 12:13 PM, Pacific Daylight Time. It is noted that this was a physical meeting with 2 individuals attending virtually (with some difficulty due to problems with the virtual system). There was a slight delay in starting the meeting as the lunch food was outside of the room instead of inside as usual. Both the Chairman, Bill Radasky, and the Vice Chairman, Mike McInerney were present. The Secretary, Pina Dall' Armi-Stoks, was not present. Radasky welcomed the attendees, reviewed the agenda and asked for suggested changes; none were offered. Radasky made a motion to approve the agenda. Motion Seconded and Carried (MSC).

2) **Review and approval of minutes of previous TC 5 meeting – Bill Radasky, Chairman**

The unconfirmed minutes from the virtual TC 5 meeting scheduled for Glasgow, Scotland on 28 July 2021 were approved without any changes.

3) **TC 5 membership list update – All**

The TC 5 membership list covering the past 5 years was reviewed. The previous membership list was displayed without email addresses, and it was noted that several attendees during the past 2 virtual meetings do not have email addresses known. Thus it will not be possible to reach them by email. We had 20 attendees at this meeting with 18 in person and 2 virtual. We do not publish the detailed 5-year list on the website or in the minutes, as there may be private information contained in it. Only the officers' and subcommittee chairs' email addresses are published on the website, and this procedure has been approved by the IEEE.

4) **Report on the paper review process and sessions for Spokane – Bill Radasky**

Radasky reviewed the paper review process for this Spokane conference and also the tutorials and special sessions that were presented. There were 2 regular, 1 abstract and 11 special session papers submitted; 13 were accepted. We ended up with 2 full special

sessions (EM Information Leakage and HEMP) and one tutorial dealing with HEMP. In addition we supported an "Ask the Experts' panel.

We had a large contingent of reviewers this year, and they should be recognized for their hard work. The reviewers were: Butterfield, Hayashi, Horton, Khazhinsky, Leferink, McInerney, Minteer, Nam, Radasky, Savage, Schamiloglu, Shen and Willemen.

The 2 special sessions were presented on Wednesday and Thursday mornings:

- SS-WE-AM1-TC5: Wednesday, 3 August 2022
  - Hardware Security for Smart Society – Parts 1 & 2
  - Organizer: Yuichi Hayashi

- SS-TH-AM1-TC5: Thursday, 4 August 2022
  - E1 HEMP Coupling to Power Substation Cables – Parts 1 & 2
  - Organizers: Robert Olsen and William Radasky

A tutorial was presented on Monday morning:

- TU-MO-AM-3: Monday, 1 August 2022
  - Recent Advancements in HEMP, EMP, and IEMI Protection – A Global Perspective
  - Organizer: Frank Sabath
  - Presentations by: Tara Kellogg, Eric Easton, Nicolas Mora, Frank Sabath

With regard to the "Ask the Experts", this was supported by TC 5:

- Ask the Experts: Tuesday, 2 August 2022
  - Understanding the Havana Syndrome
  - Organizer: Robert Olsen
  - Experts: Ken Foster, William Radasky

It is especially notable that 3 papers submitted for this conference, all in the special session dealing with E1 HEMP, were nominated for best conference paper. Although they were not selected, it is an honor to be nominated. The papers are:

- Simulation of EMP Coupling Using Electromagnetic Transient Solvers," Joshua Butterfield and Randy Horton
- "Coupling of E1 High-Altitude Electromagnetic Pulse to Signal and Control Wires in an Electric Power Substation Yard Trench," Robert Olsen, Joshua Butterfield, Johnny Moore and Timothy Minteer
- "The Application of NEC-4 to E1 High-Altitude Electromagnetic Pulse Coupling to Electric Power Substation Yard Cables," Johnny Moore and Timothy Minteer

In addition, the 1 regular paper accepted for this conference was nominated for best student conference paper. It was not selected, however, it is an honor to be nominated. The paper is:

- "Modeling an ESD Gun Discharge to a USB Cable," by Yang Xu, Jianchi Zhou, Daryl Beetner, Javad Meiguni, David Pommerenke, Sergej Bub, Steffen Holland

In addition to the paper reviews for this conference, several TC 5 experts (Hayashi, McInerney, Radasky and Savage) provided reviews for 12 HPEM papers submitted for the APEMC 2022 conference, now planned for Beijing in September 2022.

Further details can be found on this agenda item in the Attachment covering this agenda item.

5) **Report from the Lightning Subcommittee – Marcos Rubinstein and Farhad Rachidi**

A presentation audio/visual presentation was prepared by Marcos Rubinstein and Farhad Rachidi. Marcos prerecorded his voice while presenting the charts. It is noted that there were problems with our virtual attendees in hearing the presentation as the audio did not come from the system that was set up for the virtual attendees. The conferences and other events planned and held thus far in 2022 were presented along with the events planned for 2023. Also 9 WGs in CIGRE Study Committee C4 currently working were identified during the presentation. One WG in IEEE PES was also mentioned. In addition, other lightning activities were summarized. A workshop is planned for the 2023 IEEE EMC Symposium.

Further details can be found on this agenda item in the Attachment covering this agenda item.

6) **Report from the EM Information Leakage Subcommittee – Yuichi Hayashi**

Yuichi Hayashi provided his report beginning with an overview of the special session on Hardware Security for Smart Society in this year's conference. He also mentioned the activities that they have supported in the IEEE Digital Privacy Initiative. As for future plans, they are examining the possibility of having a special session or workshop on Supply Chain Security in 2023. Finally it was mentioned that from 20-24 May 2024, APEMC and Japan's EMC2024 will be combined in Okinawa, Japan so there will definitely be coverage of EM Information Leakage at this symposium. Of course all EMC researchers are welcome to submit papers and attend.

Further details can be found on this agenda item in the Attachment covering this agenda item.

7) **Report from the HEMP/IEMI Subcommittee – Mike McInerney**

Mike McInerney presented the HEMP/IEMI report in two parts. For the HEMP aspects, Bill Radasky provided a summary of activities (which have continued since 2021 including:

- The U.S. Department of Energy has published an open document to specify recommended HEMP waveforms to use to evaluate the vulnerability of the U.S. infrastructure. Many power companies are reacting to this development.
- The IEC updating IEC 61000-2-9 (HEMP radiated environment)

- The IEEE Power Energy Society is preparing a white paper dealing with the protection of protective relays from HEMP (to be published in 2024).
- CIGRE Study Committee C4 has a working group considering approaches to protect high voltage power control house electronics against HEMP
- Power companies are investigating ways to protect their electronics from HEMP (and IEMI)

With regard to the IEMI aspects Sven Fisahn reported on the 5 tutorials/special sessions presented on IEMI at the 2021 Glasgow virtual conference. He also mentioned a special session organized in Germany at the German forum for URSI in 2021. He also referred to the tutorial on HEMP and IEMI protection that was held on Monday of this conference.

Further details can be found on this agenda item in the Attachment covering this agenda item.

8) **Report from ESD Subcommittee – Shubhankar Marathe and Misha Khazhinsky**

Shubhankar Marathe presented the report from the ESD subcommittee. He discussed the paper exchange program between ESDA and the IEEE EMC Society. In particular the EOS/ESD Symposium scheduled for September 2022 has 3 invited papers from the EMC Society, and there will also be 4 seminars presented to the attendees.

Further details can be found on this agenda item in the Attachment covering this agenda item.

9) **Coordination with SC-1, Smart Grid – Mike McInerney**

McInerney introduced the activities of Special Committee 1 (Smart Grid), which is a coordinating committee, and he indicated that the SC 1 meeting had been held on Monday, with good attendance. It is noted that Mike McInerney is the Chairman of SC 1 and Bill Radasky continues in his role as Vice Chair and Dave Thomas is the Secretary. McInerney commented that TC 5 is keeping track of any issues involving Smart Grid and HPEM, and both the Chair and the Vice Chair of TC 5 have been attending the SC 1 meetings for many years.

10) **TC 5 web page – Mike McInerney, Vice Chairman**

Mike is continuing in his role as webmaster for TC 5. He is able to quickly update the website. He looks forward to comments from any members with regard to documents that could be placed on the site. In response to a question during this meeting about the scopes of the various subcommittees of TC 5, Mike mentioned that it is all on the website. The webpage for TC 5 can be found at: https://www.emcs.org/tc-5-high-power-electromagnetics.html

11) **Review of HPEM activities since last TC 5 virtual meeting in Glasgow – All**

Due to a lack of time, there was no detailed discussion concerning new developments in HPEM. McInerney asked that any new documents of a public nature be sent to him to post on our website.

12) **TC 5 Tutorials/Special Sessions planned at the EMC 2023, Grand Rapids**

Based on the presentations provided at this meeting from the subcommittees, it appears that several workshops/tutorials or special sessions will be proposed. One of the difficulties in predicting exactly which proposals will be made, is that given the "ending" of Covid restrictions in most places of the world, many conferences will be restarting, and our subcommittee members work with many conferences. It is expected that in the December time frame, new proposals will be due, and the Chairman, Bill Radasky, will remind the subcommittee chairs to identify their plans for the 2023 conference. Also it is important that all proposals be coordinated with the management of TC 5 in order to ensure the proper endorsements are made.

13) **Discussion of Standardization Activities**

After many years of discussion concerning the need for a new IEEE standard dealing with the effects on electronics when an aircraft is struck by lightning, a new PAR 28.38 has been approved. It is titled, "Aircraft Component Lightning Strike Direct Effects Qualification." Fred Heather mentioned that he is still looking for more experts to join the WG, and he expects to organize a meeting in the coming months.

A second topic was raised before the meeting by Tim Cash in an email to Bill Radasky. Tim was concerned that the new 5G transmitters may not be properly protected from lightning and that a new standard may be needed. He wanted to recommend that the IEEE EMC Society begin such an effort. There was discussion about whether cellular towers were so different that the existing lightning grounding procedures were not adequate. This question was not easy to answer, as there was no one in the room that was familiar with the current lightning "standards" for existing cellular towers. There was a statement from the floor, that it was clear that any existing standards had not been written by the EMC Society. It was more likely to be written by a lightning protection organization. The management of TC 5 will investigate what lightning protection standard exists for 4G and which organization has written the standard.

There was a third standardization activity mentioned by Andrew Podgorski. He recommended that TC 5 sponsor activity in writing an IEEE standard (or standards) to protect the critical infrastructures. Bill Radasky mentioned that the IEC has already written 22 standards and reports dealing with HEMP/IEMI and protection (including the critical infrastructures), and that there is an agreement at the highest levels between the IEEE and the IEC to not duplicate each other's standards. So it would be difficult to start a new IEEE standard without violating this agreement.

14) **Election of TC 5 Officers for 3-year Term**

The current officers of TC 5 are serving a 3-year term that ends on 31 December 2022 and therefore a new election must be held (announced in the agenda). Bill Radasky and Mike McInerney announced that they were willing to stand for re-election for a new 3-year term for Chairman and Vice-Chairman, respectively. Pina Dall' Armi-Stoks, the current Secretary was not present in the meeting or on the virtual link. Additional nominations for Chair and Vice-Chair were requested and none were made. A volunteer for Secretary was received by Yuichi Hayashi. No other volunteers or nominations were made.

Fred Heather moved that the 3 nominees be voted on as a "slate", and this motion was seconded and voted positively. The nominees then left the room, and Frank Sabath organized the voting process for the slate. After the nominees returned to the room, he informed the slate that they had been elected for 3 more years (1 January 2023 – 31 December 2025).

15) **Any other business - All**

Dr. Dave Giri has been selected for this year's IEEE EMC Society Hall of Fame Award, which will be presented on Thursday at the Awards Luncheon. Those of us who have worked in the HPEM area for many years know Dave and his excellent work. We in TC 5 wish to add our congratulations. As Dave did not attend the TC 5 meeting, Bill Radasky said that he would pass our congratulations to him at the Award's Luncheon.

16) **Adjournment**

The meeting was adjourned at 1:30 PM.

Attachments (labeled with agenda item)

2-Approved Glasgow Minutes
4-Report on Paper Review Process
5-Lightning Subcommittee Report
6-EM Information Leakage Subcommittee Report
7-HEMP/IEMI Subcommittee Report
8-ESD Subcommittee Report

IEEE TC 5: High Power Electromagnetics (HPEM) Technical Committee
On the web at https://www.emcs.org/tc-5-high-power-electromagnetics.html

Minutes of Glasgow Virtual Meeting by WEBEX
Wednesday, 28 July 2021 (10:00 a.m. – Noon Central U.S. Time)

Confirmed Minutes

1) **Opening of the meeting and approval of the agenda – Bill Radasky, Chairman**

Chairman Dr. William (Bill) Radasky brought the virtual meeting to order at 10:00 a.m. Central U.S. Time. Both the Chairman, Bill Radasky, and the Vice Chairman, Mike McInerney were present. The Secretary, Pina Dall' Armi-Stoks, was not present due to the time difference in Australia. Radasky welcomed the attendees, reviewed the agenda and asked for suggested changes; none were offered. Radasky made a motion to approve the agenda. Motion Seconded and Carried (MSC).

2) **Review and approval of minutes of previous TC 5 meeting – Bill Radasky, Chairman**

The unconfirmed minutes from the virtual TC 5 meeting in Reno on 3 August 2020 were reviewed and approved without any changes.

3) **TC 5 membership list update – All**

The TC 5 membership list over the past 5 years was reviewed. Mike McInerney was able to make several screen shots of the online attendees for this WEBEX meeting; there were 19 unique attendees, which is a reduction from past years. There were a few new members, so the 5-year membership list (including email addresses) will be updated to be used to contact our membership. We do not publish the detailed 5-year list on the website or in the minutes, as there may be private information contained in it. Only the officers' and subcommittee chairs' email addresses are revealed on the website, and this procedure has been approved by the IEEE.

The existing attendance list (before the meeting) was shown at the meeting, and new members will be added to the 5-year list.

4) **Report on the paper review process and sessions for Glasgow – Bill Radasky**

Radasky reviewed the paper review process for Glasgow virtual conference and also the tutorials and special sessions that were presented virtually. There were 26 regular, abstract and special session papers submitted; 22 were accepted. We ended up with 4 technical sessions and 1 special session (ESD). The review process was difficult due to the new software, and a new problem arose this year. For many years the tutorial and special session process had run smoothly, but this year there were several proposals submitted without an indication of support from TC 5. While support is not necessarily required, there should at least be a review from the TC for items within their scope. If a tutorial or special session proposal is not of high quality, we could recommend that the tutorial or special session not be accepted. Discussions with the tutorial chairs at the end of the process were successful in that in the future, "unsupported" tutorial proposals will be sent to TCs which cover the scope of the tutorial. Also a special session did not mark support from TC 5 (one covering ESD), and TC 5 was asked at the last minute to review the papers in the session. This was done successfully, but could have been accomplished more easily if TC 5 was aware of the session.

We had a large contingent of reviewers this year, and they should be recognized for their hard work. The reviewers were: Hayashi, He, Homma, Khazhinsky, Leferink, McInerney, Rachidi, Rubinstein, Sabath, Savage, Thomas, and Willemen.

There was a special session on ESD entitled, "Robust Design for System Level ESD: Device, PCB and System Level," organized by David Pommerenke.

There were also five tutorials presented:

- Modeling of IEMI Scenarios organized by Frank Sabath
- Protection of Critical Infrastructures Against IEMI organized by Michael Suhrke and Martin Schaarschmidt
- HPEM Effects on Electronic Systems organized by Frank Sabath
- Achieving ESD Robustness Through System Efficient ESD Design Simulation organized by David Pommerenke
- Recent Advancements in HEMP, EMP and IEMI Protection – A Global Perspective organized by Joel Kellogg and Dave Giri

During this virtual conference there was a live session scheduled: "Ask the Experts". TC 5 experts contributed to two of the sessions in the areas of lightning and ESD.

In addition to the paper reviews for this Glasgow virtual conference, several TC 5 experts (Hayashi, McInerney, Radasky and Savage) provided reviews for HPEM papers for the APEMC 2021 conference planned for Bali in September 2021.

5) **Report from the Lightning Subcommittee – Marcos Rubinstein and Farhad Rachidi**

A comprehensive report was presented covering lightning conferences and other planned activities, either virtual and/or cancelled for 2021 and those planned for 2022 (10 separate events). Four lightning working groups are actively working in CIGRE Study Committee

C4 and a working group in the IEEE PES is also active. As for 2022, the lightning subcommittee plans to organize a lightning session at the EUROEM/ASIAEM Symposium in Abu Dhabi in 2022, and will support the Spokane IEEE EMC Symposium in 2022 through encouraging technical papers to be submitted. Since this IEEE EMC symposium was held virtually this year, we have decided to attach the charts presented at this WEBEX TC 5 meeting to these minutes. This presentation is found in Attachment 1.

6) **Report from the EM Information Leakage Subcommittee – Yuichi Hayashi**

Yuichi Hayashi provided his report beginning with an overview of the regular session papers (3) presented this year. He has also organized a special session for APEMC to be presented in Bali in September 2021. It is entitled, "Hardware security issues due to EM passive/active attacks on devices complying with EMC standards." He is planning to organize a special session for Spokane in 2022 tentatively entitled, "Hardware security required for the next generation of cryptography and electronic devices". His report is presented in Attachment 2.

7) **Report from the HEMP/IEMI Subcommittee – Mike McInerney**

Mike McInerney presented the HEMP/IEMI report in two parts. For the HEMP aspects, Bill Radasky provided a summary of activities including:

- The U.S. Department of Energy has published an open document to specify recommended HEMP waveforms to use to evaluate the vulnerability of the U.S. infrastructure
- The IEC has taken steps to update IEC 61000-2-9 (HEMP environment)
- The IEEE Power Energy Society is preparing a white paper dealing with the protection of protective relays from HEMP
- CIGRE Study Committee C4 has a working group considering approaches to protect high voltage power control house electronics against HEMP
- Power companies are investigating ways to protect their electronics from HEMP (and IEMI)

With regard to the IEMI aspects Frank Sabath reported on the tutorials scheduled for this conference in the field of IEMI (see the list under item 4 of these minutes). Also an update on the IEC work dealing with IEMI was provided. Frank Sabath mentioned that due to a recent promotion, he will no longer be able to support the HEMP/IEMI subcommittee, but recommends that Sven Fisahn take over this responsibility (Sven provided a presentation dealing with the research from his organization, and this presentation will be discussed under agenda item 11). This recommendation was appreciated and accepted, and we all wish Frank Sabath good luck in his future endeavors. The full report for this subcommittee can be found in Attachment 3.

8) **Report from ESD Subcommittee – Joost Willemen and Misha Khazhinsky**

Joost Willemen presented the report from the ESD subcommittee. He reviewed the paper submission process for regular papers and for the special session on ESD. He also

discussed the paper exchange program between ESDA and the IEEE EMC Society. He also reviewed the significant list of ESD standards that have been published in 2021. The details of this presentation are found in Attachment 4.

9) **Coordination with SC-1, Smart Grid – Mike McInerney**

McInerney introduced the activities of Special Committee 1 (Smart Grid), which is a coordinating committee, and he indicated that the SC 1 meeting will be held virtually on 9 August. It is noted that Mike McInerney is the new Chairman of SC 1 and Bill Radasky continues in his role as Vice Chair and Dave Thomas is the Secretary. McInerney commented that TC 5 is keeping track of any issues involving Smart Grid, and both the Chair and the Vice Chair of TC 5 have been attending the SC 1 meetings for many years.

He also mentioned that there is ongoing work in Smart Electric Power Alliance (SEPA) that deals with EMC and high power EM environments. There are several white papers that have been published that deal with the EMC aspects of Smart Grid. Don Heirman was the long-time chairman of the EMC work and after his passing, Bill Radasky has become the new chair.

10) **TC 5 web page – Mike McInerney, Vice Chairman**

McInerney reported on the new process for allowing technical committees to update their web pages. There were a few technical problems with the update process, but Mike was able to update the TC 5 site. He has some remaining cleanup to do to populate the subcommittee pages with regard to open documents, and he looks forward to comments from any members with regard to documents that could be placed on the site. The webpage for TC 5 can be found at: https://www.emcs.org/tc-5-high-power-electromagnetics.html

11) **Review of HPEM activities since last TC 5 meeting in Reno – All**

Radasky opened up discussion on new activities worldwide in our area of work. Sven Fisahn provided a presentation covering the work of his organization in Germany: Bundeswehr Research Institute for Protective Technologies and NBC Protection (WIS). The presentation covered the work underway in HEMP, IEMI and other HPEM areas. The presentation was approved for open distribution and is found in Attachment 5.

A second discussion was led by Dr. Nicholas Mora who is the Director of Electromagnetic Effects at Directed Energy Research Centre within the Technology Innovation Institute in Abu Dhabi, UAE. He indicated that his group is active in organizing virtual workshops in the areas of HEMP and IEMI and that they are building up a simulation capability at their centre.

Another discussion was led by Dr. Andrew Podgorski, concerning the need to standardize threat waveforms for very high level HPEM threats. He did not think that the work in the IEC nor MIL-STD-464 was sufficient for this purpose. It might be a good idea for Andrew

to submit a paper describing this need so that we may consider whether there are any actions that TC 5 might consider in the future.

New plans for updating several standards of the IEC for HEMP environments and protection were discussed under item 7 of this agenda, so this information was not repeated here during the discussion.

12) **TC 5 Tutorials/Special Sessions planned at the EMC 2022, Spokane**

Based on the presentations provided at this meeting from the subcommittees, it appears that the following proposals are likely for the 2022 conference in Spokane:

- Special session on "Hardware security required for the next generation of cryptography and electronic devices," from the EM Information Leakage Subcommittee
- Tutorial covering the update of HEMP environments and protection standards in IEC SC 77C
- Lightning and ESD subcommittees plan to promote regular paper submissions

As usual this is the preliminary list, and it is likely that more proposals may be forthcoming near the proposal submission date.

13) **Update on aircraft lightning direct strike standardization - All**

After many years of discussion concerning the need for a new IEEE standard dealing with the effects on electronics when an aircraft is struck by lightning, a new PAR 28.38 has been approved. It is titled, "Aircraft Component Lightning Strike Direct Effects Qualification." Fred Heather reviewed the scope of the project and asked for the support of TC 5 in this work. We continue to recommend to our members that they join this standards committee if they have interest in the subject.

14) **Any other business - All**

Nicholas Mora mentioned that a webinar on Directed Energy was planned for the November/December time frame, and he indicated that information on this webinar would be forthcoming.

Bill Radasky mentioned that one of our active participants in TC 5 was to be presented with an important award at the Awards "Luncheon" which had not yet been held. It was recommended that this award not be mentioned during the meeting, but since these minutes have been written after the award was publicized, we can now congratulate our colleague. A Technical Achievement Award from the IEEE EMC Society was presented to Prof. Yuichi Hayashi "For contribution to threat analysis of EM information security and application of EMC countermeasures against threats." As Chairman of the EM Information Security Subcommittee for TC 5 and an active researcher in the field, this award is richly deserved.

15) **Adjournment**

The WEBEX meeting was adjourned at 12:05 p.m. U.S. Central Time.

TC-5 Meeting, Friday, Jul 28 2021, Virtual

Report on Lightning Activities

M. Rubinstein F. Rachidi

Main Events with Lightning Related Content in 2021

- AMS Annual meeting, ~~New Orleans~~, Jan 10-14 (Virtual)
- IEEE EMC & SIPI, ~~Raleigh, NC, Apr 30- May 6~~ and International Symposium on EMC and EMC Europe, ~~Glasgow, Scotland, Jul 30 – Aug 6~~ (Combined virtual, Jul 26-Aug 20)
- APEMC & EMC ~~25-28 May~~, Bali, Indonesia (Sep 27-30)*
- GROUND & LPE conference, ~~Jun 2 to 5, 2021, Belo Horizonte, Brazil~~ (Virtual, Jun 2-4)
- ICLP/SIPDA, ~~Colombo~~ (Virtual, Sep 20-26)
- EUROEM/ASIAEM, ~~Abu Dhabi, 2020~~ (Postponed to early 2022)
- URSI GASS, Rome, Italy (On-site with provision for on-line, Aug 28-Sep 4)
- AGU Fall Meeting Dec 13-17, New Orleans (Online and in-person)

*The APEMC 2021 conference is still planned to be in-person, with the possibility of pre-recorded presentations for those people who are not able to attend the conference in-person. All sessions will also be recorded and made available for registered participants after the conference.

Main Events with Lightning Related Content in 2022

- Int. Conf. on Atm. Electricity, Jun 19-24, Tel Aviv, Israel
- EUROEM/ASIAEM, early 2022 (no dates yet)
- ICLP, South Africa (Oct 2-7)
- ILDC/ILMC (neither dates nor venue announced at this time)
- APEMC, Beijing, China (May 8-11)
- GROUND & LPE conference (neither venue nor dates announced yet)
- IEEE EMC & SIPI, Aug 1–5, Spokane, Washington
- EUROEM(ASIAEM, Abu Dhabi (no dates yet)
- EMC Europe, Rome, Italy (To be held virtually September 23-25)
- CIGRE 2022 Technical Exhibition, Paris, Aug 29-Sep 2.

Approved CIGRE Working Groups on Lightning (2020 - 2022)

- WG C4.59, “Real-time Lightning Protection of the Electricity Supply Systems of the Future”, Chair: Chong Tong (China)
- WG C4.61, “Lightning transient sensing, monitoring and application in electric power systems”, Chair: Jingliang He (China)
- WG 4.66. “New concept for analysis of multiphase back-flashover phenomena of overhead transmission lines due to lightning”, Megumu Miki (Japan)
- WG4.67, Lightning Protection of Hybrid Overhead Lines, Alexandre Piantini, Brazil.

Other Working Groups

- IEEE PES Lightning Performance of Overhead Lines Working Group
  - Annual meeting will be held this year in conjunction with Virtual 2021 IEEE PES GM (which will be held from Jul 26-29).
  - In 2022, the meeting will be held July 17 - 21, Denver.

This year's activities

- Organized a Lightning: Organized together with Bob Davis an "Ask the Experts Discussion" on Aug 7
- Papers submitted to the ICLP/SIPDA conference in Colombo, September

Proposed work for 2022

- Lightning session at EUROEM/ASIAEM 2022
- Promoting lightning-related papers for IEEE EMC 2022
- Several contributions to ICLP 2022 in Cape Town, South Africa

28 July 2021

Activity Report

IEEE EMC Society TC5 Subcommittee: Electromagnetic Information Leakage

Yuichi Hayashi

2021 JOINT IEEE INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC COMPATIBILITY, SIGNAL & POWER INTEGRITY & EMC EUROPE

www.emc2021.org • #IEEE_ESP21

Regular Session in IEEE EMC + SIPI 2021

TP-THU-5A • Sponsored by TC-5

Co-Chairs: William Radasky (Metatech Corporation, Goleta, CA, USA), Yuichi Hayashi (Nara Institute Science and Technology, Japan) ,

The number of papers: 3 papers (Related to EM information leakage)

1. Multiple and Reproducible Fault Models on Micro-controller using Electromagnetic Fault Injection
2. Machine Learning Voice Synthesis for Intention Electromagnetic Interference Injection in Smart Speaker Devices
3. The Application Of The Duffing Oscillator To Detect Electromagnetic Leakage Emitted By HDMI Cables

Special Sessions in APEMC 2021

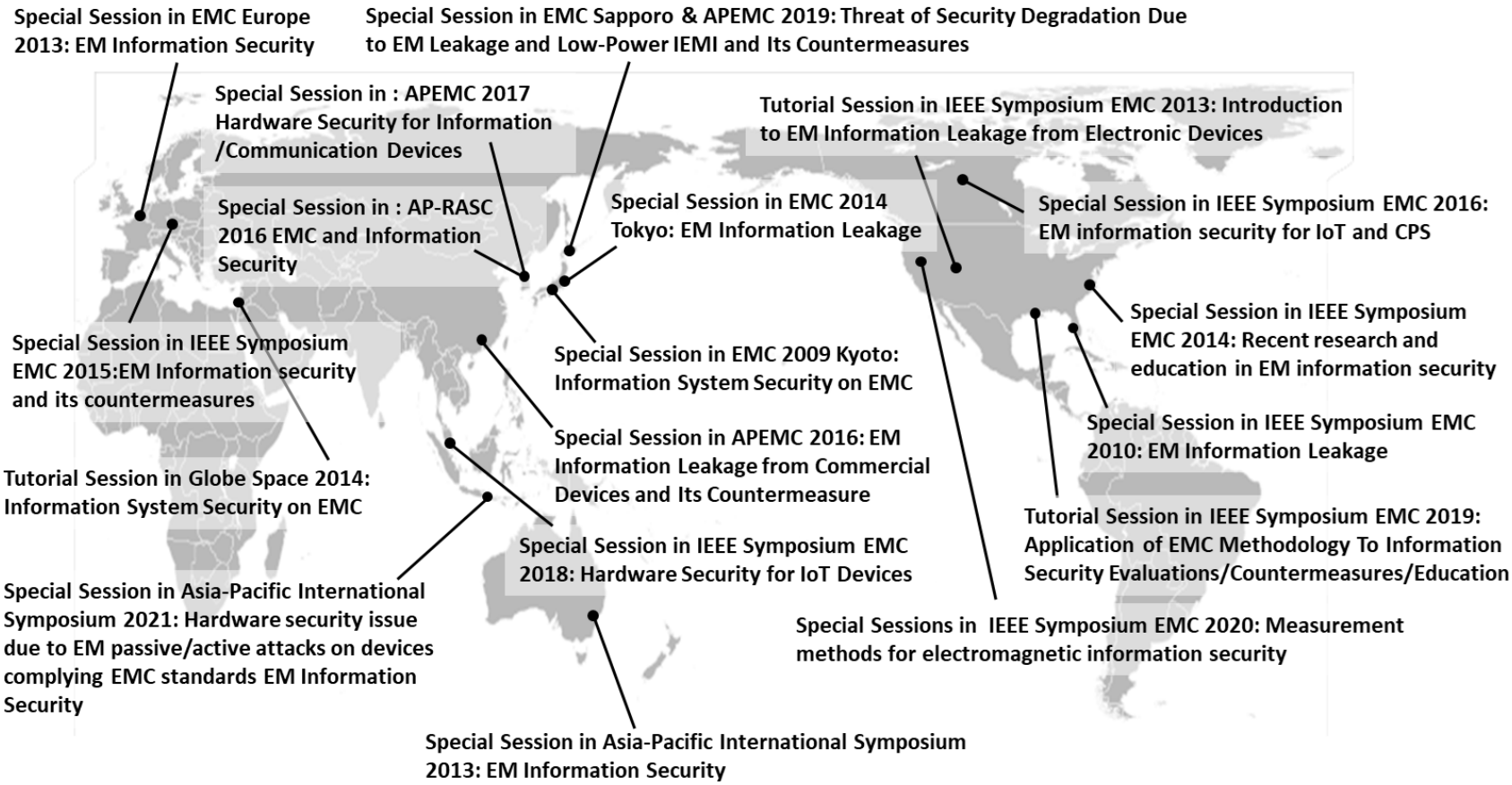
Hardware security issue due to EM passive/active attacks on devices complying EMC standards

Co-Chairs: Yuichi Hayashi (Nara Institute Science and Technology, Japan) , William Radasky (Metatech Corporation, Goleta, CA, USA)

The number of papers: 10 papers

1. Board-Level Hardware Trojan Detection Using Sensing Function of On-Board ICs in IT Devices
2. Information Leakage Through Emissions Standards for Commercial Equipment
3. A Scheme to Improve SNR of Received EMI Signal from Information Display Device
4. Investigation of the Effect of Temperature on Fault Injection Using Intentional Electromagnetic Interference
5. A Study for Low Calculation Cost Side-Channel Resistance Prediction Based on Transfer Impedance of Leakage Path
6. Analysis of Electromagnetic Information Leakage from Overdesigned Power Delivery Network of Cryptographic Devices
7. A Fundamental Evaluation of EM Information Leakage Induced by IEMI for a Device with Differential Signaling
8. A Study on Output Bit Tampering of True Random Number Generators Using Time-Varying EM Waves
9. Study on Measurement Resolution of Side-Channel Waveform in Correlation Power Analysis
10. Fundamental Study on Evaluating Immunity of RO-Based TRNGs Against Frequency Injection Attack

Research activity of EM information security in commercial devices (since 2009)



Outreach activity in future

To promote the field of information leakage, we would like to have workshop/special sessions in future EMC symposiums.

Special session in IEEE EMC + SIPI 2022
Topic: Hardware security required for the next generation of cryptography and electronic devices (tentative)

HEMP/IEMI Subcommittee Report to TC 5 (HPEM)

Mike McInerney

28 July 2021

TC5 HEMP / IEMI Subcommittee

- Created in 2020 to improve the organization of the website and ease subcommittee reporting
  - HEMP information had been placed under meeting minutes, while other subcommittees placed relevant information on their respective sub-pages
  - Since parts of HEMP and IEMI have similar fast rising time waveforms and are high power EM, they are associated
  - HEMP (and IEMI) literature is now listed on the HEMP / IEMI web page
  - Mike McInerney volunteered to be the General POC for the new HEMP / IEMI subcommittee
  - Bill Radasky volunteered to be the POC for the new HEMP subcommittee
  - Frank Sabath retained role as POC for IEMI subcommittee
  - Frank Sabath is retiring from his role as POC for IEMI subcommittee
  - Have opening for new IEMI POC

TC5 HEMP / IEMI Subcommittee

- We encourage TC5 committee members to submit information on TC5 related activities to subcommittee POCs
  - Lightning
  - EM (Information) Leakage
  - HEMP / IEMI
  - ESD

Recent HEMP Activities

- Several important HEMP activities have occurred since our last virtual conference and TC5 meeting
  1. The U.S. Department of Energy has published an open document to specify recommended HEMP waveforms to use to evaluate the vulnerability of the U.S. infrastructure
  2. The IEC has taken steps to update IEC 61000-2-9 (HEMP environment)
  3. The IEEE Power Energy Society is preparing a white paper dealing with the protection of protective relays from HEMP
  4. CIGRE Study Committee C4 has a working group considering approaches to protect high voltage power control house electronics against HEMP
  5. Power companies are investigating ways to protect their electronics from HEMP (and IEMI)
- Items 1 and 2 are discussed in more detail in the following two charts

U.S. DOE HEMP Environments

- On January 11, 2021, the U.S. Department of Energy Released a set of HEMP environments to be used for assessing the susceptibilities of the critical infrastructure
  - This was required by the HEMP Executive Order released under President Trump in March 2019
  - The waveforms recommended for E1 and E2 HEMP are identical to those published in IEC 61000-2-9
  - The waveforms for E3 Blast Wave and E3 Heave are higher than those recommended by IEC 61000-2-9
  - All of the waveforms are presented graphically and with analytic formulas
  - TC5 will place the public memo on the TC5 website
- Link: https://www.energy.gov/sites/default/files/2021/01/f82/FINAL%20HEMP%20MEMO_1.12.21_508.pdf

IEC 61000-2-9 Update Plans - 1

- IEC Subcommittee 77C has been planning to start new work and maintenance on its body of IEMI and HEMP publications
  - Several HEMP and IEMI publications will be updated
- For the HEMP radiated environment, there are several areas of IEC 61000-2-9 that have been discussed for more than 1 year to improve the standard
- The maintenance work for IEC 61000-2-9 has been recently approved
  - Project Leader: Dr. William Radasky
  - Summary of improvements are on the next chart

IEC 61000-2-9 Update Plans - 2

- Key improvements to be considered
  - Provide information for the variation of the E1 and E3 HEMP fields as a function of position. This could include sample ground contour plots and/or range dependent variations for the peak values and even the pulse shapes.
  - Consider adding a few additional analytic E1 HEMP waveforms with different rise times and pulse widths.
  - Provide a new E3 HEMP waveform (both B- and E-fields) based on new openly published information.
  - Provide information on how to compute the E3 field from the incident B-field and provide a few ground conductivity profiles for those calculations.
  - Provide an annex that shows an equivalent QEXP (Quotient of Exponentials) waveform that is more accurate above 100 MHz for the E1 HEMP waveform. This will help those who try to extend the DEXP (Difference of Exponentials) waveform in the frequency domain to frequencies well above 1 GHz.
  - Explain in another annex why the E1 HEMP waveform in time does not require a “zero area”. This has caused a great deal of confusion regarding the way the E1 HEMP waveform is specified.
  - Provide (in an annex) a simple explanation of the high-frequency approximation (HFA) so the use of the “1-D” numerical solution is not misunderstood. A comprehensive list of references could also be provided to underscore the accuracy of the HFA.

Recent IEMI Activities - 1

- Much of the activity in IEMI from 2020 – 2021 is occurring through the combined 2021 IEEE EMC/EMC Europe Symposium with 4 different tutorials dealing with IEMI being presented beginning next week
  - WT-Mon-3: Monday, 2 August 2021
    - Modeling of IEMI Scenarios
    - Organizer: Frank Sabath
  - WT-Tues-4: Tuesday, 3 August 2021
    - Protection of Critical Infrastructures Against IEMI
    - Organizers: Michael Suhrke, Martin Schaarschmidt
  - WT-Thurs-3: Thursday, 5 August 2021
    - HPEM Effects on Electronic Systems
    - Organizer: Frank Sabath
  - WT-Fri-3: Friday, 6 August 2021
    - Recent Advancements in HEMP, EMP and IEMI Protection – A Global Perspective
    - Organizers: Joel Kellogg, Dave Giri

Recent IEMI Activities - 2

- IEC SC 77C has approved maintenance on IEC/TR 61000-5-6 titled, “Electromagnetic compatibility (EMC) - Part 5-6: Installation and mitigation guidelines - Mitigation of external EM influences”
  - Dr. Richard Hoad is the project leader
- The improvements include:
  - Update the whole document to include other HPEM environments including **Intentional Electromagnetic Interference (IEMI)**
  - Add to the Scope new clauses with the concept of EM Resilience which includes the new field of HPEM detectors; recovery and restoration
  - Review the rest of the document to improve the consistency of the text with other SC 77C documents produced after this document. This would include any definitions and figures that should be updated.
  - Convert the document to become an International Standard.

ESD Update

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Michael Khazhinsky
Michael.Khazhinsky@silabs.com

Virtual TC-5 (HPEM) Meeting

July 28, 2021

ESD Technical Exchange – 2021 Updates

- ESDA Representatives (Michael Khazhinsky, Joost Willemen) participated in ESD paper review
  - 5 regular paper submissions
  - 4 special sessions submissions (Special session organizer: D. Pommerenke)
- Joost Willemen chairs TC-5 sponsored ESD session: TP-THU-5-B ESD: “ESD and Smart Grid IEMI” (Thursday, Aug 12, 2021), with Michael McInerney as co-chair
  - Only 1 paper in this session, all other papers have been reassigned to a special session
- The 2021 ESD Symposium again has a special focus on EMC and System Level related topics
  - Session with 2 invited papers
  - 2 seminars
  - “Ask the experts” session
- Paper exchange program between IEEE EMC&SIPI Symposium and ESDA continues in 2021
  - 1 paper and 1 tutorial from 2020 EMC&SIPI Symposium are presented as invited papers at the 2021 ESD Symposium
  - This year no invited papers from the 2020 ESD Symposium at the EMC&SIPI Symposium

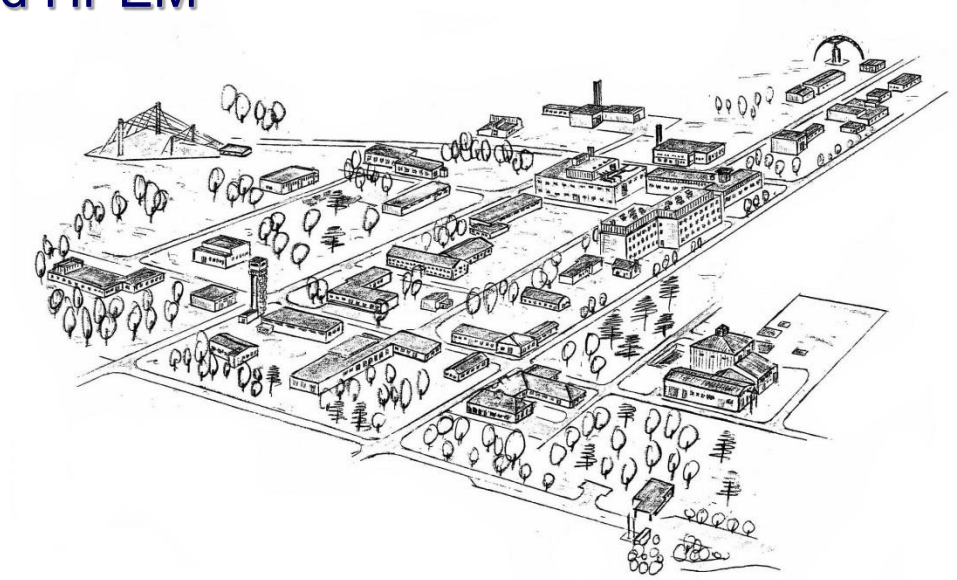
ESD Standards – 2021 Updates

- Mil Std 1686 and Mil HBK 263 were withdrawn, and military is now using ANSI/ESD S20.20 and ESD TR20.20 for ESD control program requirements.
- Published an update to the Technology Roadmap in October 2020.
- John Kinnear is the IEC TC101 chairman as of January 1, 2021.
- 10 ESD standard documents have been published in 2021:
  - ANSI/ESD SP3.5 - Test Methods for Air Assist Bar Ionizers, Soft X-Ray (Photon) Ionizers, Room Ionization Alternatives, and Non-Airflow Alpha Ionizers
  - ANSI/ESD STM7.1 - Flooring Systems - Resistive Characterization
  - ANSI/ESD S8.1 – Symbols
  - ANSI/ESD STM11.11 - Surface Resistance Measurement of Planar Materials
  - ANSI/ESD STM11.12 - Volume Resistance Measurement of Planar Materials
  - ANSI/ESD SP14.5 – Near Field Immunity Scanning - Component/Module/PCB Level
  - ANSI/ESD SP17.1 - Process Assessment Techniques
  - ESD TR5.5-05-20 - Transmission Line Pulse (TLP) – Transient Response Evaluation
  - ESD TR18.0-02-20 - Latch-up Electronic Design Automation (EDA)
  - ESD TR23.0-01-20 - Electrical Overstress in Manufacturing and Test
- Upcoming document releases:
  - ANSI/ESD S20.20 – ESD Control Program Requirements
  - ESD TR53-01 – Compliance Verification Test Methods
  - ANSI/ESD S1.1 – Wrist Straps
  - ANSI/ESD STM11.13 – Two Point Resistance Measurement
  - ANSI/ESDA/JEDEC JS-002 – Charged Device Model (CDM)
  - ESD JTR002-01 – User Guide for ANSI/ESDA/JEDEC JS-002

Attachment 5
28 July 2021

Bundeswehr Research Institute for Protective Technologies and NBC Protection (WIS)

Branch 320
Electromagnetic Effects and HPEM



Branch Head 320:

Dr. Martin Schaarschmidt

TOC

- Introduction WIS
- High-Power Electromagnetics (HPEM)
- Equipment & Facilities
- R&D Projects

Bundesministerium
für Bildung
und Forschung

General information about the WIS

German Research Map:
Federal Research Institutions

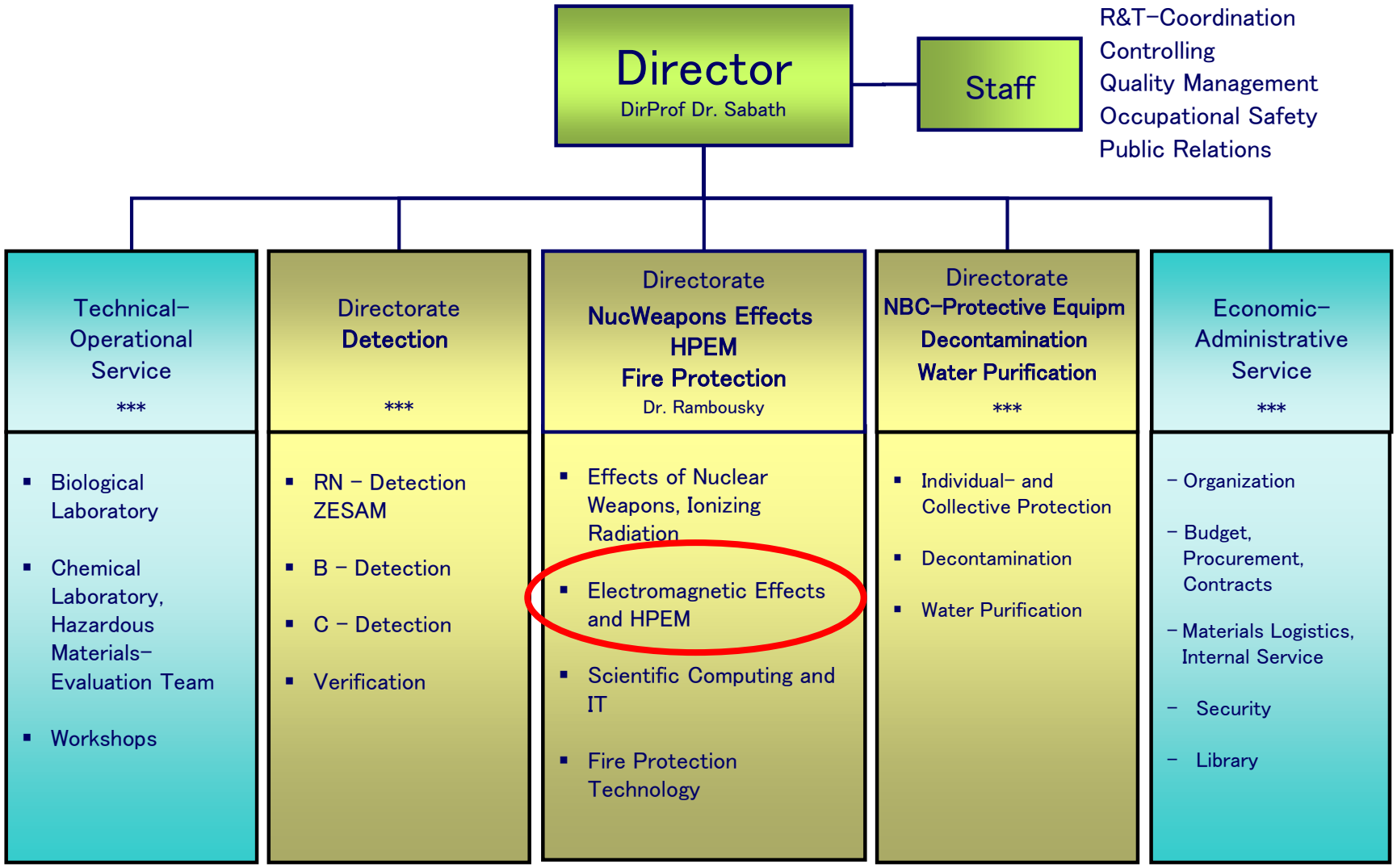
Sven Fisahn

Bundeswehr Research
Institute for Protective
Technologies and
NBC Protection (WIS)

Branch 320
Electromagnetic Effects and HPEM

Mission:
Research, Testing and Advice on
Electromagnetic Effects and HPEM

Organization WIS



Mission GF 320 – Electromagnetic Effects and HPEM

Research

- Research & Technology (R&T) Projects on HPEM
  - Interaction mechanisms of HPEM with electronic components and systems
  - Protection measures against HPEM effects

Testing

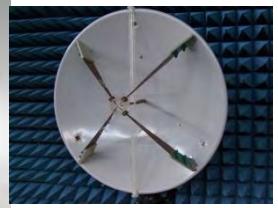
- Qualification testing to ensure HPEM hardess of military equipment and other security relevant systems and facilities
- Assessment of potential HPEM weapons and their effects
- Participation in standardization working groups (national, international, military, civil)

Advice

- Guidance to the Armaments Directorate (MoD) concerning protection of military equipment against HPEM attacks
- Support of the Armaments Directorate (MoD) concerning HF personnel safety by scientific assessment and measurements

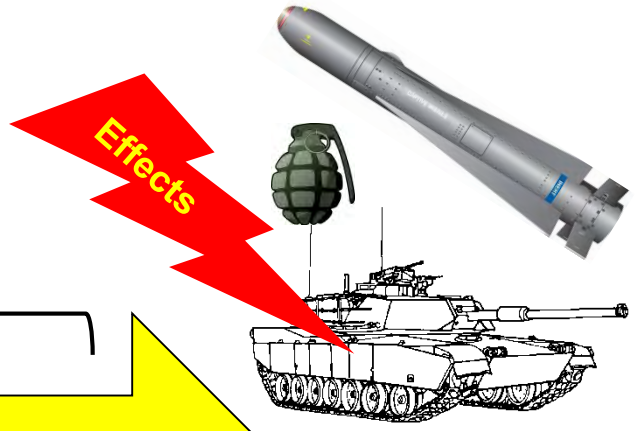
Research & Technology (R&T) – Context / Focus

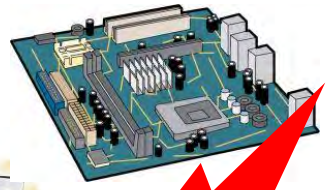
Numerical EM-Field Simulation
CEM (PROTHEUS)

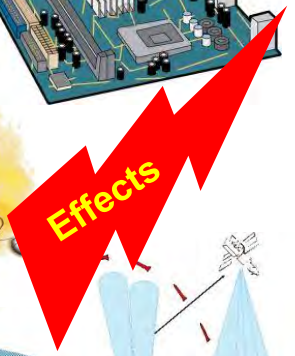


EM-Fields
wave propagation

EM-Coupling



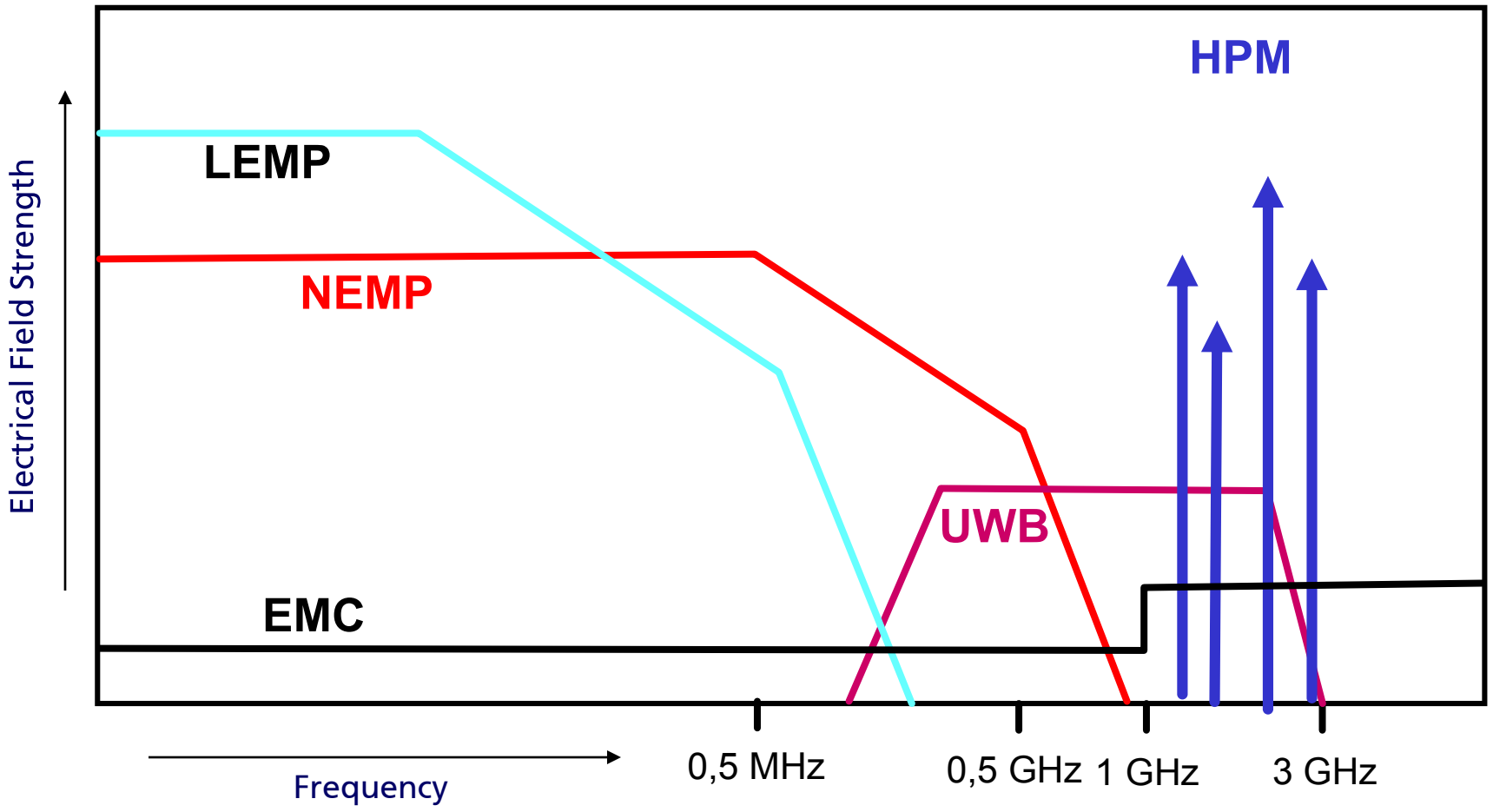




HPEM-Effector

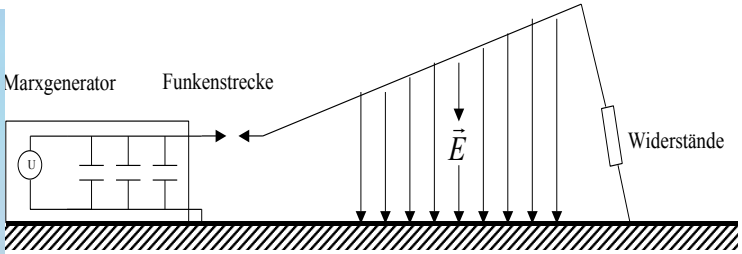
HPEM-Interaction
HPEM-Protection
HPEM-Qualification Testing
HPEM-Standardization

Frequency ranges of electromagnetic effects



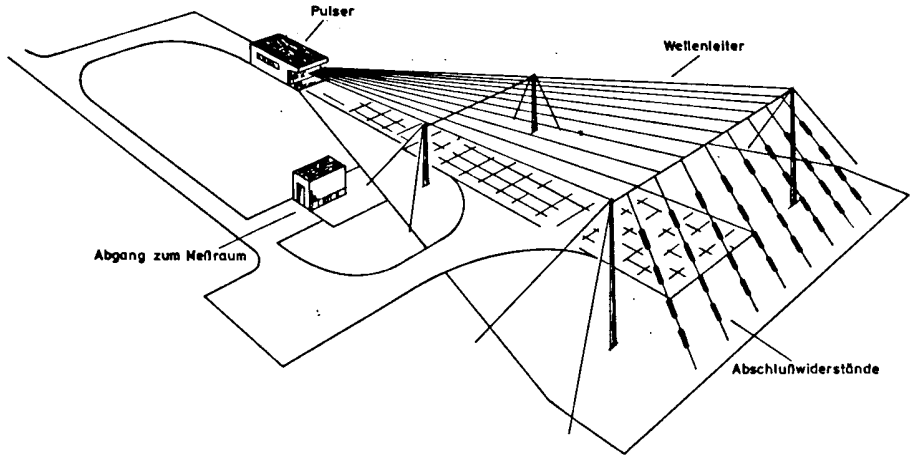
- Introduction WIS
- High-Power Electromagnetics (HPEM)
- Equipment & Facilities
- R&D Projects

NEMP Simulators – TEM-Waveguide DIESES



TEM-Waveguide

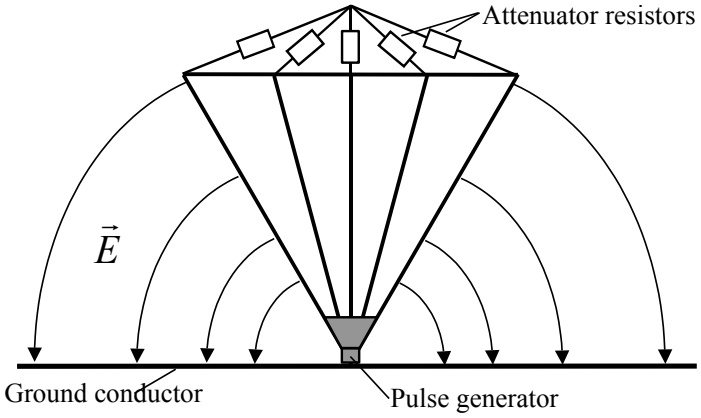
Rise time:	1.0 - 2.5 ns
Pulse duration:	25 - 50 ns
Amplitude:	1 kV/m - 100 kV/m
Test volume:	10 m x 10 m x 10 m



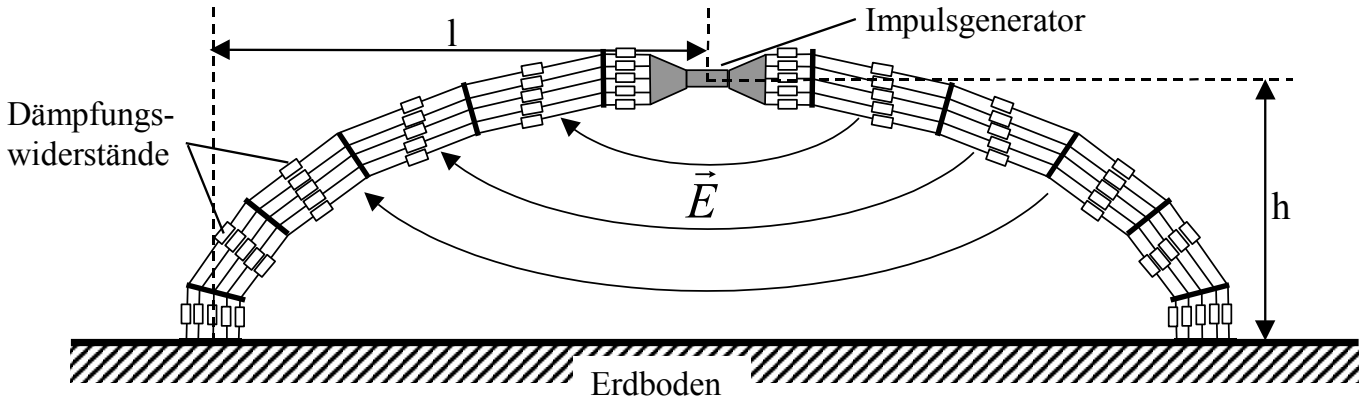
NEMP Simulators – VPD

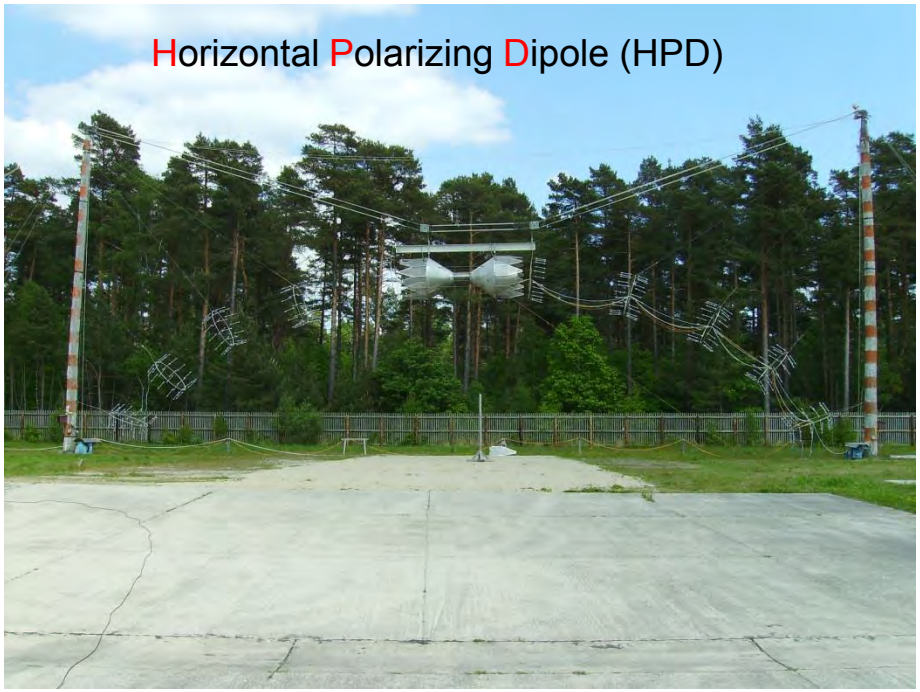
Vertical Polarizing Dipole (VPD)

Rise time:	2.5 ns
Pulse duration:	25 ns
Amplitude:	1 kV/m - 15 kV/m
Test volume:	10 m x 10 m x 6 m



NEMP Simulators – HPD

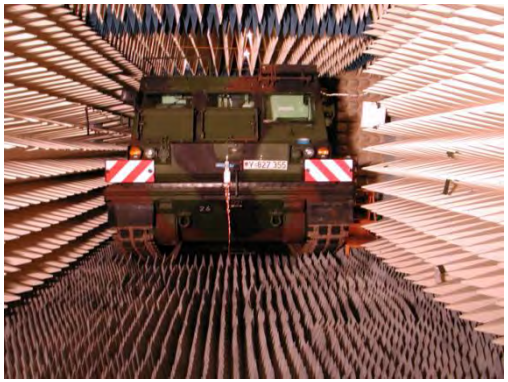


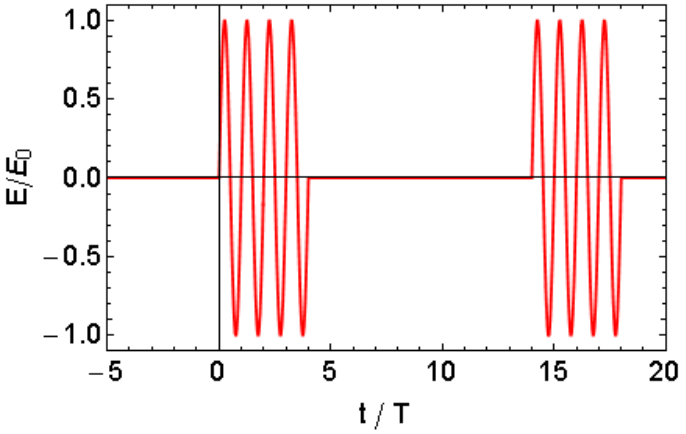


Rise time:	1 ns - 3 ns
Pulse duration:	10 ns - 20 ns
Amplitude:	1 kV/m - 50 kV/m
Test volume:	10 m x 10 m x 6 m

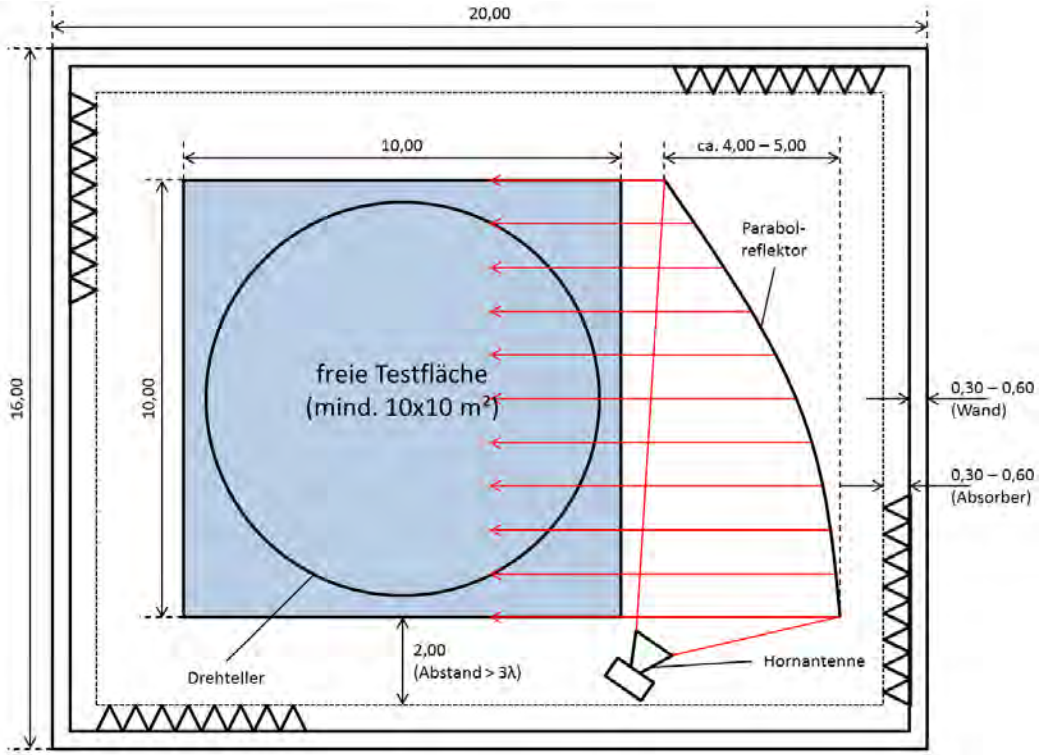
High-Power Microwave Facility – SUPRA

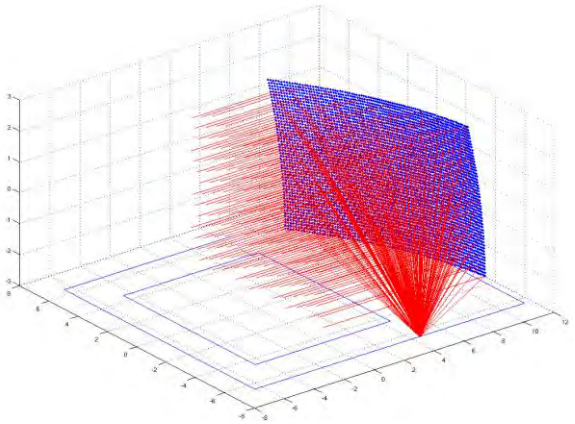
- 8x super reltrons
- frequency range: 685 MHz – 3 GHz
- mean power: 100 MW bis 500 MW
- effektive field in 15 m distance: >50 kV/m
- illumination area in 15 m distance: 4 m x 3 m
- pulse duration: > 300 cycles
- Pulse repetition frequency: up to 10 Hz
- Pulses per Burst: <100





High-Power Microwave Facility – SUPRA – Projected Extension





GTEM-Cell

- Dimensions: (7,8 x 2,8 x 4,1) m
- Frquency range: 0 Hz – 18 GHz
- Input for pulsed signals up to 50 kV (e.g. NEMP pulse)

HPEM-Laboratory – Open TEM Waveguide

- obere Grenzfrequenz: 8 GHz
- max. Eingangsspannung: 50 kV
- integrierte Feldsensoren (E-Feld)
- Testvolumen: 1 m x 1 m x 1 m

Mobile HPM-Source

HPEM-Laboratory –UWB Generator

PBG3:

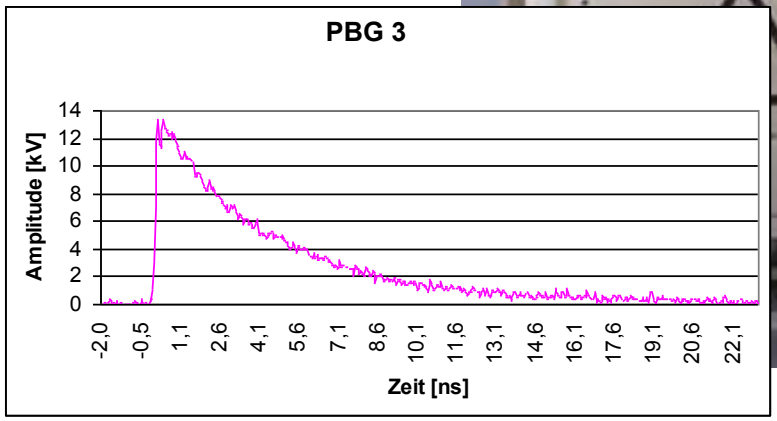
- Multifunktionaler UWB-Pulsgenerator auf Halbleiterbasis
- Ausgangsspannung: 12 kV
- Ansteigszeit: 100 ps
- Pulsdauer: 5 ns
- Wiederholrate: 100 Hz

PBG7:

- Multifunktionaler UWB-Pulsgenerator auf Halbleiterbasis
- 4 Ausgänge je 12 kV, t_{rise} = 100 ps (für Phased-Array-Systeme)
- oder ein Ausgang 45 kV, t_{rise} = 150 ps, Pulsdauer 3 ns
- Wiederholrate: 500 Hz

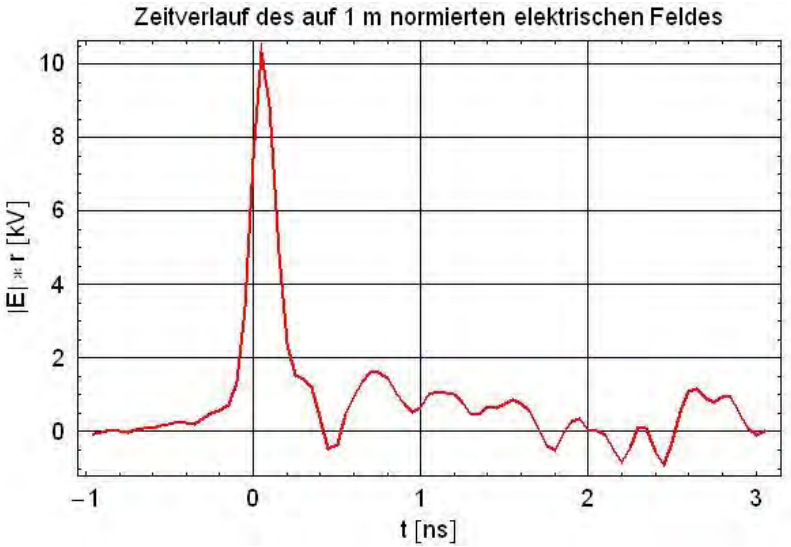
Verwendbare Antennensysteme:

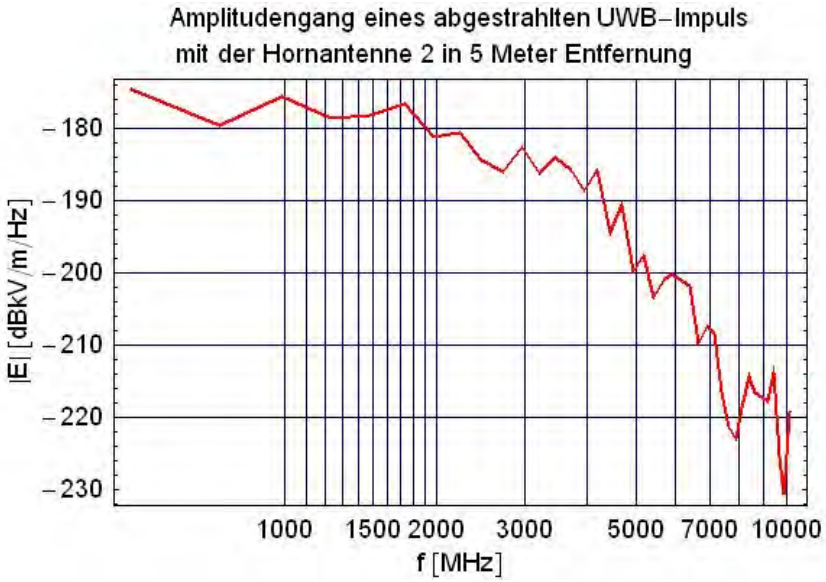
- Impuls Radiating Antenna (IRA)
- Half Impuls Radiating Antenna (HIRA)
- Hornantennen
- TEM-Wellenleiter

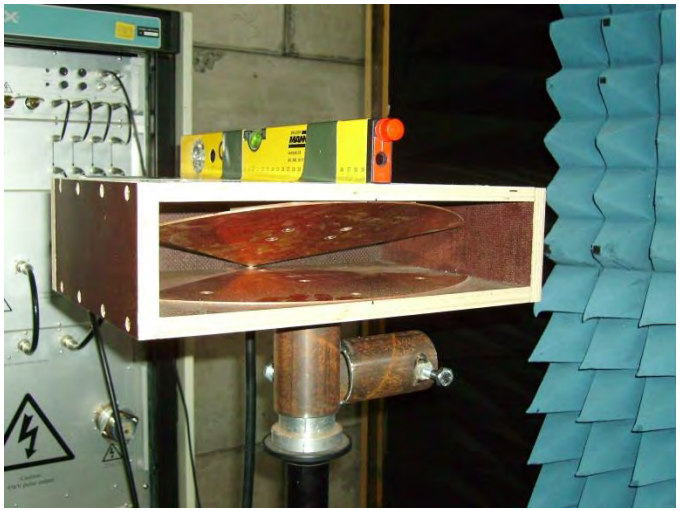


HPEM-Laboratory – Horn Antennas

- obere Grenzfrequenz: 4,5 GHz
- max. Eingangsspannung: 13 kV
- 4 Antennen vorhanden





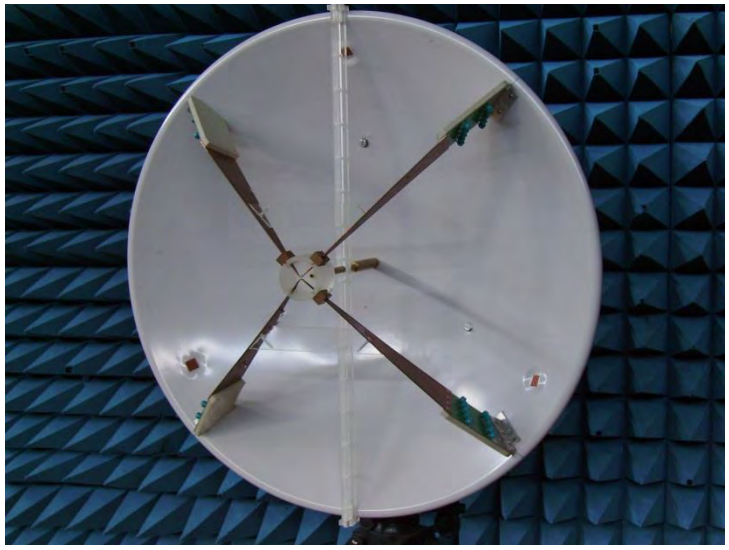


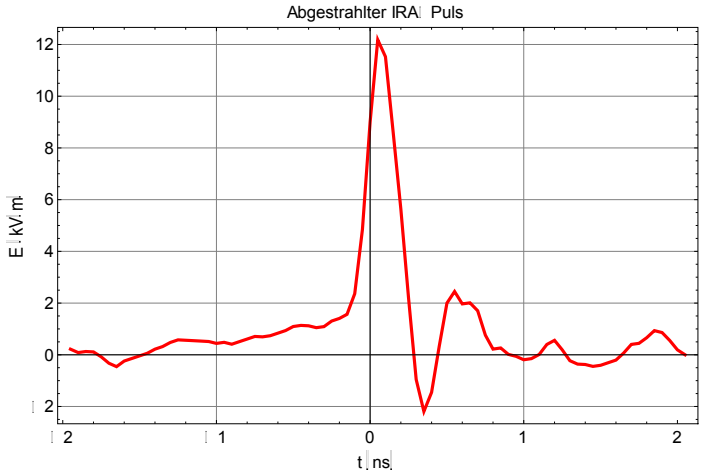
HPEM-Laboratory – Impulse Radiating Antenna (IRA)

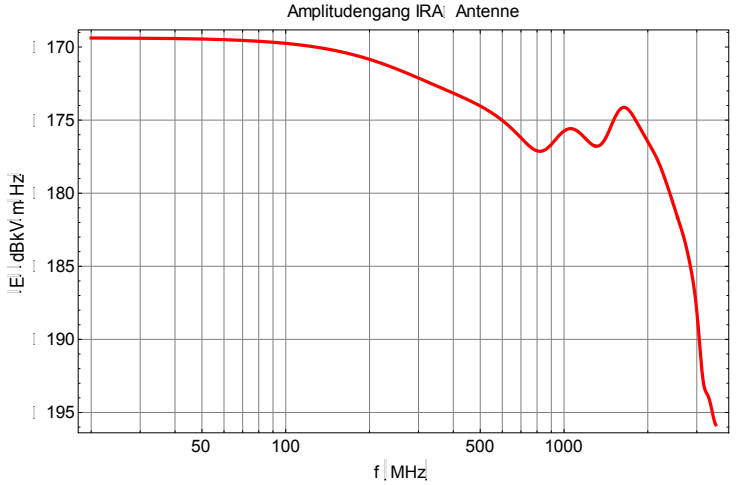
Impulsabstrahlende Reflektorantennen

Durchmesser Apertur:	0,9 m	1,8 m
Max. Spannung:	12,5 kV	50 kV
Obere Grenzfrequenz:	2,5 GHz	n.n
Bandbreite:	1,5 GHz	n.n
r E:	10 kV	n.n

Impuls Radiating Antenna (IRA)







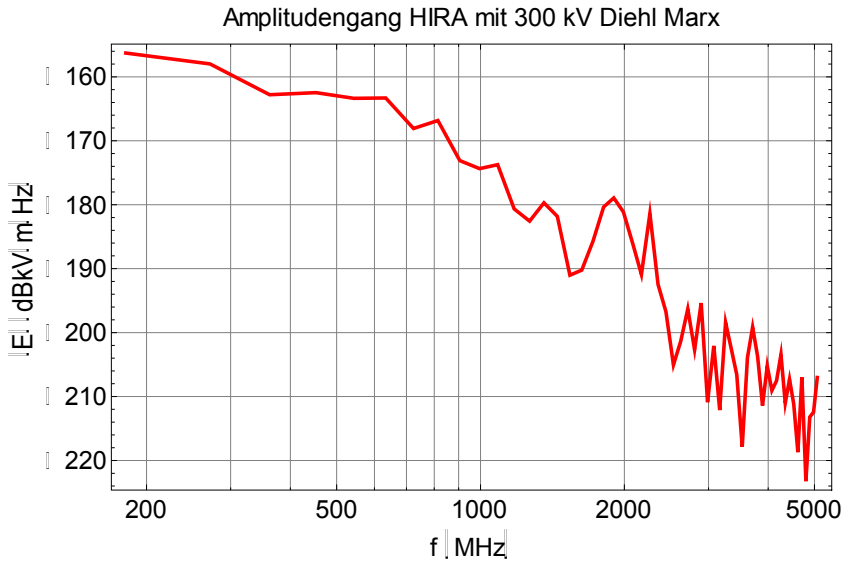
HPEM-Laboratory – Half Impulse Radiating Antenna (HIRA)

Impulsabstrahlende Reflektor-Halbantenne

Durchmesser Apertur:	1,8 m
Max. Spannung:	600 kV
Obere Grenzfrequenz:	2,2 GHz
Bandbreite:	1 GHz
r E:	790 kV

Adaption an verschiedenste Impulsquellen des WIS
(Marxgeneratoren, pulserzeugende Netzwerke)

Half Impuls Radiating Antenna (HIRA)



TOC

- Introduction WIS
- High-Power Electromagnetics (HPEM)
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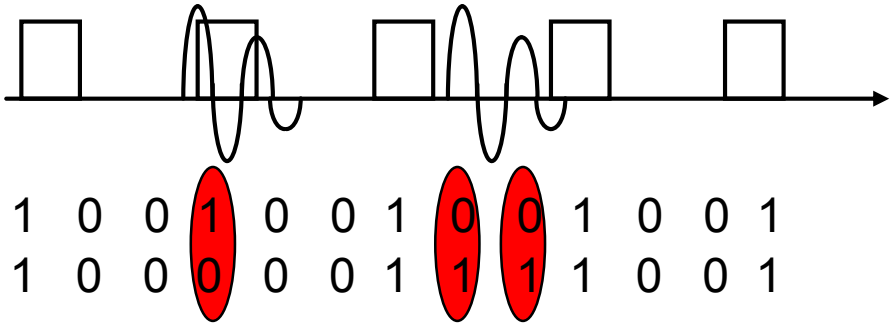
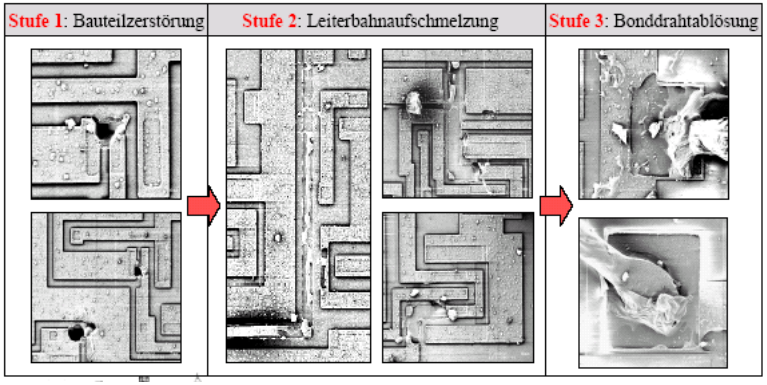
- R&D Projects

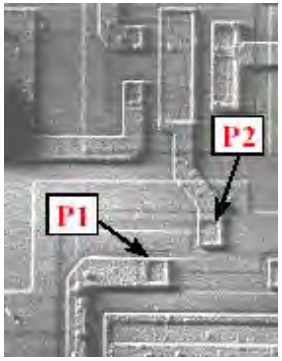
Physical Effects

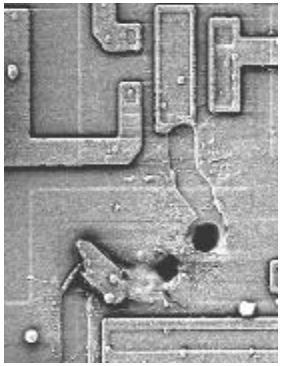
Bit-Flip

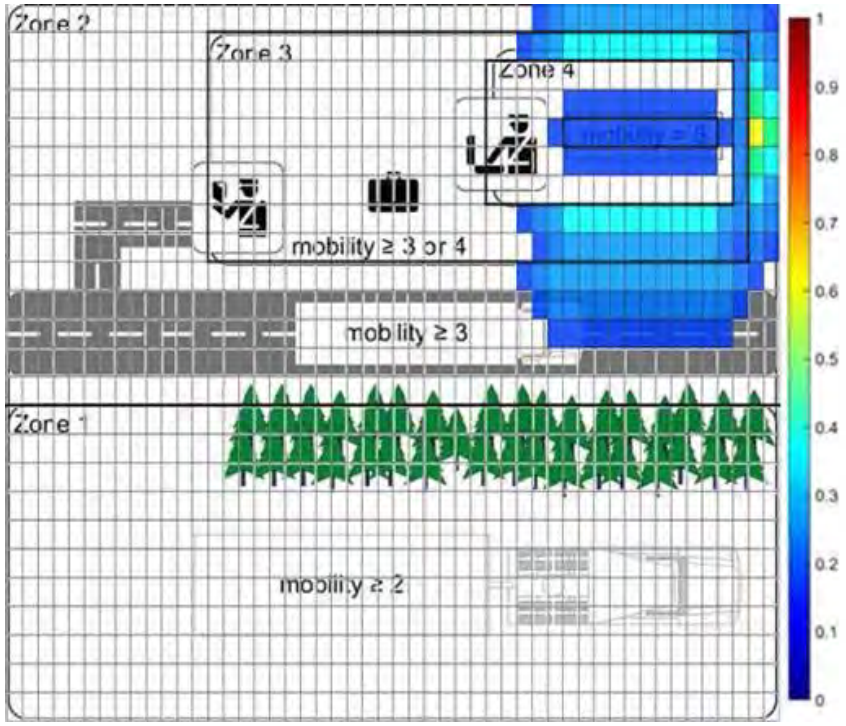




Physical Destruction







Example: Airport Check-In

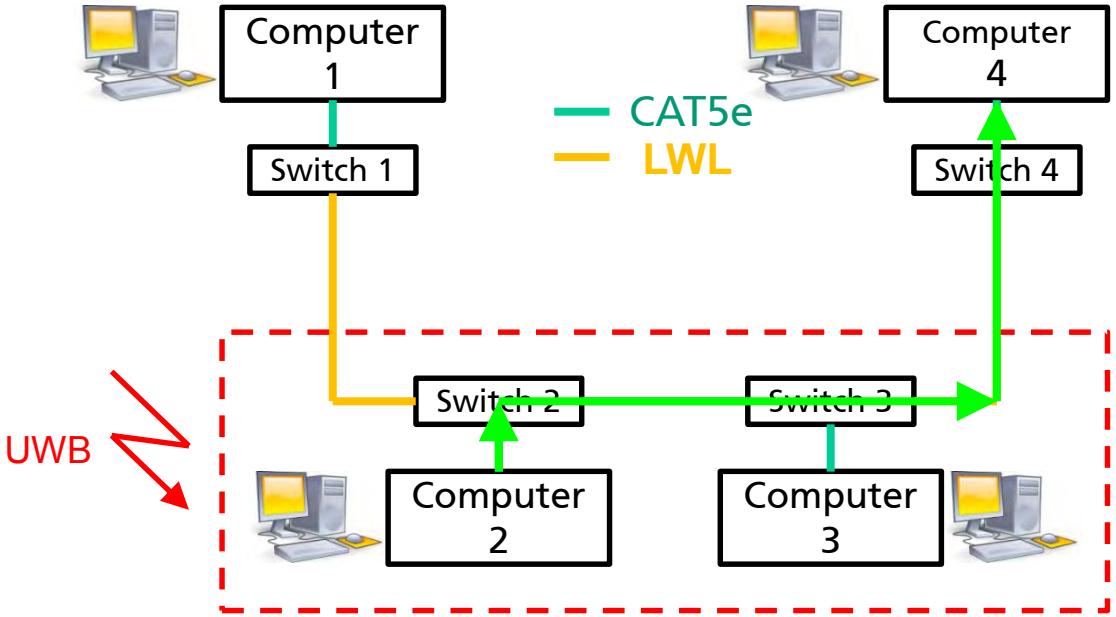
- Fuzzy-Logic based
- Nontechnical parameters
- Expert knowledge
- Information deficit

statistical-theoretical evaluation
Functional description

EmOM

Intelligent Network Protection

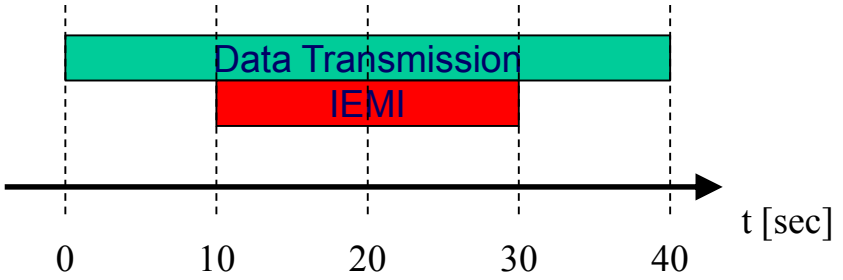
Network Protection - Setup



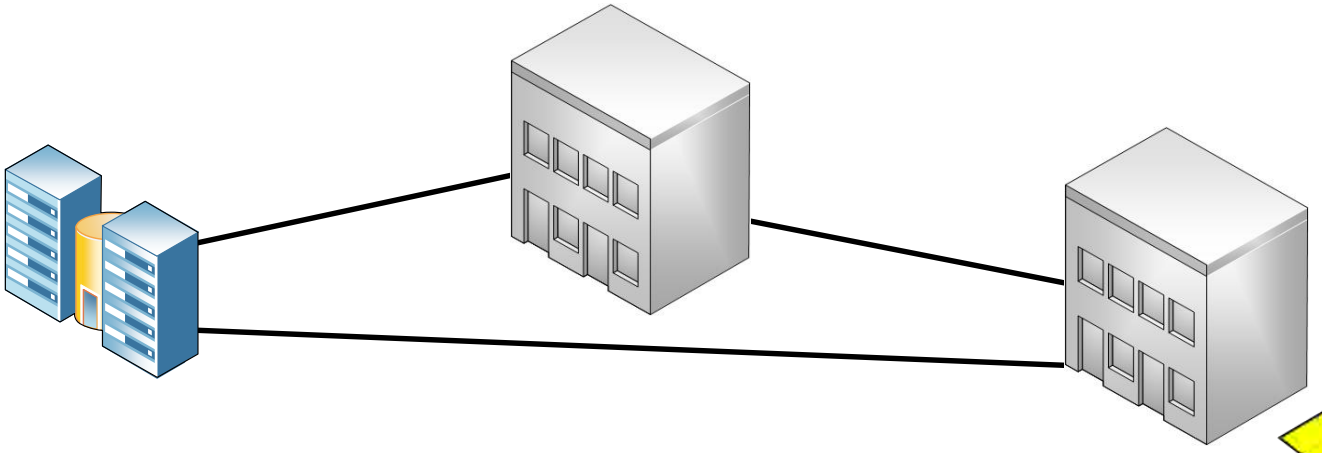
Parameters

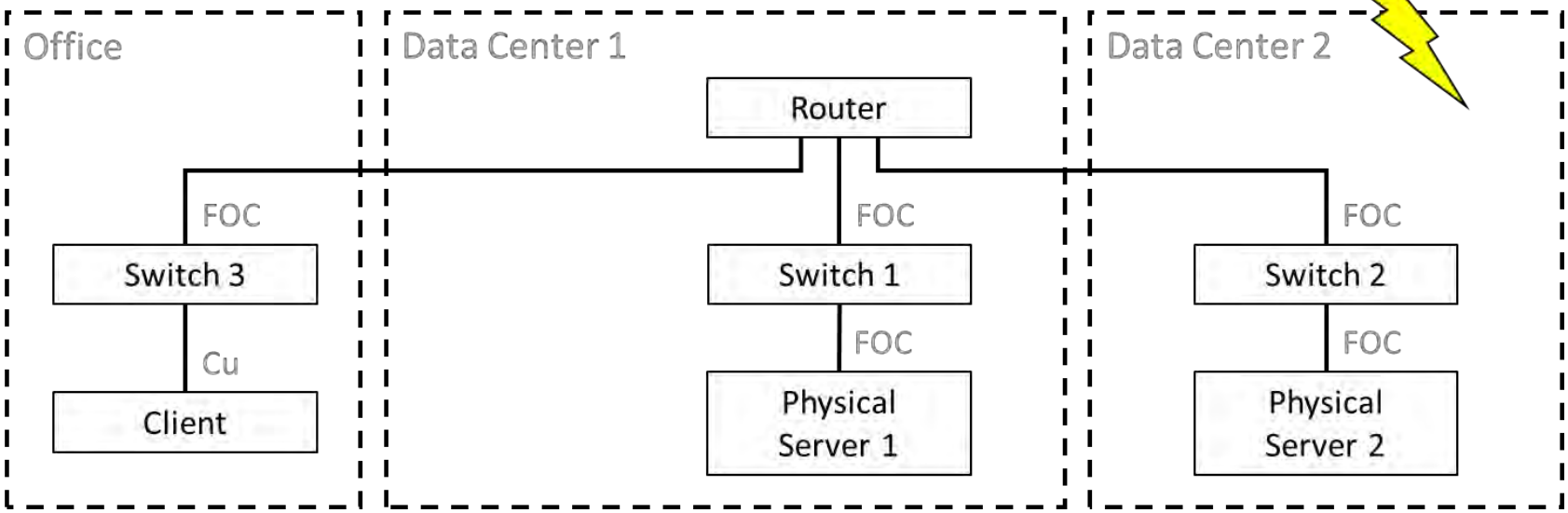
- 7,5 kV/m vertikal
- Rep-Rate: 0, 10, 50, 100, 200,…, 800 Hz
- transmission: 40 sec
- Interruption: 20 sec

Resilience of Redundant Server Infrastructure



Resilience of Redundant IT Infrastructure





Defence against UAV/UAS

UAV = unmanned aerial vehicle
UAS = unmanned aerial system

HPEM capabilities

- jamming
- Sensor interruption
- Processing interruption

Spiegel-Online vom 16.09.2013

CotS UAV					
Merkmal	Reely 650 ARF	GAUI 500X-S	Flame Wheel	Phantom	Multicopter 800 S
Beschaffung	DEU	DEU	NATO	NATO	NATO
Anzahl	1	1	4	4	2
Steuerung	35 MHz	2,4 GHz	2,4 GHz	2,4 GHz	2,4 GHz
GPS	nein	ja, externes Modul	ja	ja	ja
Autonomes Landen (Coming Home)	nein	ja	ja	ja	ja
Autonomer Flug (Wegpunktnavigation)	nein	ja	nein	nein	ja
Größe (Linie Motor – Motor entlang der Arme)	66 cm	50 cm	56 cm	35 cm	80 cm
Flugzeit	20 min	20 min	20 min	20 min	15 min
Nutzlast	800 g	1400 g	300 g	150 g	2000 g
Einstufung	Modellbau/ Hobby	Modellbau/ Hobby mit MIKADO vergleichbar	Modellbau/ Hobby	Semiprofessionell	Professionell mit MIKADO vergleichbar

Standardization

NEMP

Nat.: VG Normen
Intern.: AECTP 250/500

Test facilities:
Waveguide „DIESES“
HPD, VPD

R&D Activities:
Interconnected IT-Systems /
TEM-Waveguide
(AF119)

UWB DS

Nat.: -
Intern.: AECTP 250/500

Test facilities
UWB Pulser + Antenna
DS Pulser
UWB/DS TEM-Waveguide

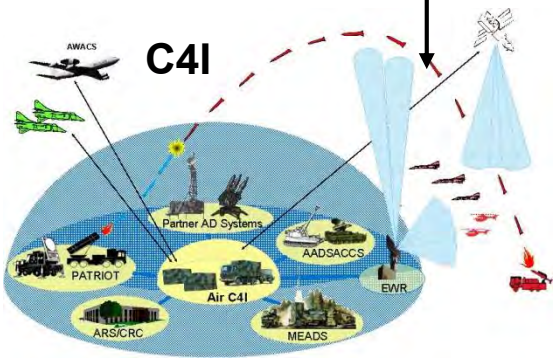
R&D Activities:
NATO RTO SCI-250
Joint Systems (CF149)

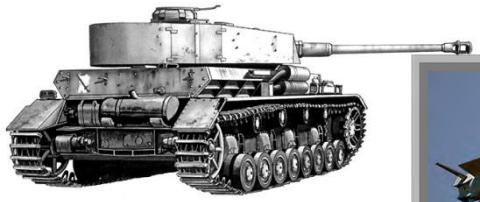
HPM

Nat.: -
Intern.: AECTP 250/500

Test facilities
HPM facility „SUPRA“
Extended anechoic chamber

R&D Activities:
HPM Testprocedures (CF162)
Mobile Source (FF027)





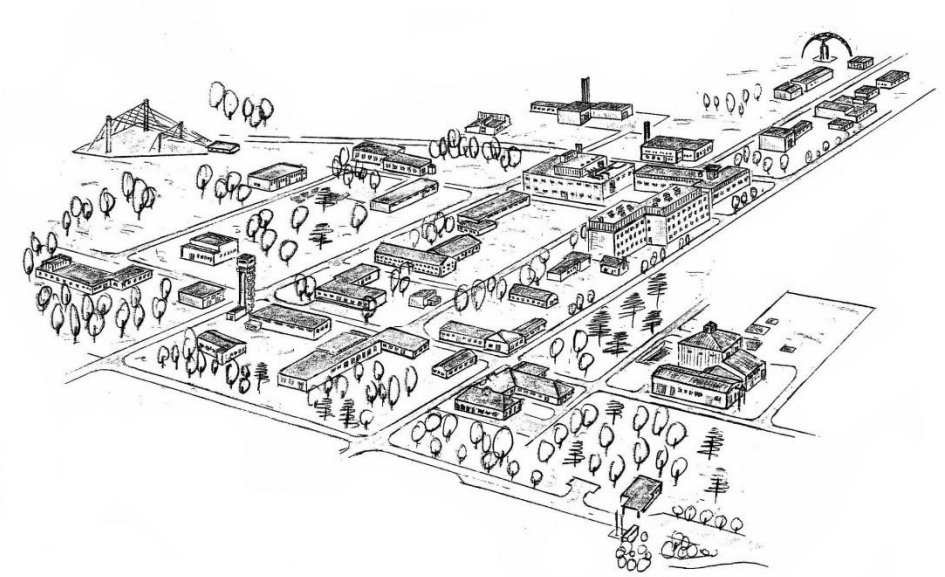
- EMC+SIPI 2021 Virtual:
  - **Tutorial** by Frank Sabath: Modeling of Intentional Electromagnetic Interference (IEMI) Scenarios
  - **Workshop** by Frank Sabath, Dave Giri and Richard Hoad: HPEM Effects on Electronic Systems
  - **Workshop** by Martin Schaarschmidt and Michael Suhrke: Protection of Critical Infrastructure against Intentional Electromagnetic Interference
  - **Technical Session** by Mike McInerney and Frank Sabath: IEMI Generators and Modeling
  - **Technical Session** by Frank Sabath and Mike McInerney: Intentional EMI and HEMP
  - **Technical Session** by Tim Claeys: Risk-based EMC
    ➔ MSCA-ITN „PETER“

- MSCA ITN "PETER - Pan-European Training, Research & Education Network on Electromagnetic Risk Management"
  ➔ https://etn-peter.eu/

- Kleinheubacher Tagung 2021(German forum of the URSI)
  - **Plenary Session** by Frank Sabath: EMI Risk Management
  - **Special Session by Sven Fisahn:** Risk Analysis and German activities within MSCA ITN "PETER - Pan-European Training, Research & Education Network on Electromagnetic Risk Management"

Thank you for your attention!

Questions ?



2022 IEEE EMC Society TC 5 Paper Review Process and Tutorials, Special and Regular Sessions

Prepared by

Bill Radasky, TC 5 Chair

3 August 2022

TC5

Paper Review Process

- We reviewed 2 regular papers, 1 abstract paper, and 11 special session papers on HEMP and EM Information Leakage (14 papers in all)
  - 1 regular paper was accepted, as were all 11 of the special session papers
  - Last year we had 26 total papers to review, but the reduction in submitted papers was in line with the significant reduction in all papers submitted for this conference
- The reviewers did a great job in spite of some problems with the new review software
  - Butterfield, Hayashi, Horton, Khazhinsky, Leferink, McInerney, Minteer, Nam, Radasky, Savage, Schamiloglu, Shen, Willemen

Special Sessions and Ask the Experts

- Ask the Experts: Tuesday, 2 August 2022
  - Understanding the Havana Syndrome
  - Organizer: Robert Olsen
  - Experts: Ken Foster, William Radasky
- SS-WE-AM1-TC5: Wednesday, 3 August 2022
  - Hardware Security for Smart Society – Parts 1 & 2
  - Organizer: Yuichi Hayashi
- SS-TH-AM1-TC5: Thursday, 4 August 2022
  - E1 HEMP Coupling to Power Substation Cables – Parts 1 & 2
  - Organizers: Robert Olsen and William Radasky

Special Sessions - 2

- SS-TH-AM1-TC5: Thursday, 4 August 2022
  - E1 HEMP Coupling to Power Substation Cables – Parts 1 & 2
  - Organizers: Robert Olsen and William Radasky
- 6 papers are part of this special session and 3 papers were nominated for best conference paper
  - “Simulation of EMP Coupling Using Electromagnetic Transient Solvers,” Joshua Butterfield and Randy Horton
  - “Coupling of E1 High-Altitude Electromagnetic Pulse to Signal and Control Wires in an Electric Power Substation Yard Trench,” Robert Olsen, Joshua Butterfield, Johnny Moore and Timothy Minteer
  - “The Application of NEC-4 to E1 High-Altitude Electromagnetic Pulse Coupling to Electric Power Substation Yard Cables,” Johnny Moore and Timothy Minteer

Tutorials

- TU-MO-AM-3: Monday, 1 August 2022
  - Recent Advancements in HEMP, EMP, and IEMI Protection – A Global Perspective
  - Organizer: Frank Sabath
  - Presentations by: Tara Kellogg, Eric Easton, Nicolas Mora, Frank Sabath
- As this tutorial was already held on Monday, it is noted that approximately 50 people attended, which is a very good turnout

Regular TC 5 Papers

- Only 2 regular papers were reviewed and 1 was accepted
  - It was placed with the EM Info leakage special session
- The one regular paper was nominated as best EMC Student Paper
  - “Modeling an ESD Gun Discharge to a USB Cable,” by Yang Xu, Jianchi Zhou, Daryl Beetner, Javad Meiguni, David Pommerenke, Sergej Bub, Steffen Holland

APEMC Reviews

- APEMC TC 4 deals with HPEM transients and EM Information Leakage
  - IEEE TC 5 members have performed reviews for many years (since 2008)
- 12 papers were reviewed
  - Reviewers included Hayashi, McInerney, Radasky, Savage
- Conference was scheduled for May 2022, but moved to later in 2022

TC-5 Meeting, August 2022

Report on Lightning Activities

M. Rubinstein
F. Rachidi

Main Events with Lightning Related Content in 2022

- ILDC/ILMC (Cancelled due to Covid restrictions in several countries around the world)
- URSI AT-AP-RASC 2022. May 29 - Jun 3, Gran Canaria, Spain
- Int. Conf. on Atm. Electricity. Jun 19-24, Tel Aviv, Israel
- IEEE EMC & SIPI. Aug 1–5, Spokane, Washington
- CIGRE 2022 Technical Exhibition and Congress. Aug 28-Sep 2, Paris, France
- APEMC. Sep 1-4, Beijing, China
- EMC Europe. Sep 5-8, Gothenburg, Sweden
- ICLP. Oct 2-7, Cape Town, South Africa
- GlobalEM 2022. Nov 13-17, Abu Dhabi, UAE

Main Events with Lightning Related Content in 2023

- AMS Annual meeting. Jan 8-12, Denver, USA
- IEEE EMC & SIPI, Jul 31-Aug 4, Grand Rapids, Michigan, USA
- URSI GASS 2023. Aug 19-26, Sapporo, Hokkaido, Japan
- EMC Europe 2023. Sep 4-8, Krakow, Poland
- APEMC. Venue and dates not yet announced
- AGU Fall Meeting. Dec 11-15, San Francisco, USA

CIGRE Working Groups on Lightning

- WG C4.57, “Guidelines for the Estimation of Overhead Distribution Line Lightning Performance and its Application to Lightning Protection Design”, Convenor: Koji Michishita (JAPAN)
- WG C4.59, “Real-time Lightning Protection of the Electricity Supply Systems of the Future”, Chair: Chong Tong (China)
- WG C4.61, “Lightning transient sensing, monitoring and application in electric power systems”, Chair: Jingliang He (China)
- WG 4.66. “New concept for analysis of multiphase back-flashover phenomena of overhead transmission lines due to lightning”, Megumu Miki (Japan)
- WG4.67, Lightning Protection of Hybrid Overhead Lines, Alexandre Piantini, Brazil.
- WG C4.69, “Quantifying the lightning response of tower-footing electrodes of overhead transmission lines_methods of measurement”. Convener: Silverio Visacro (Brazil)
- WG C4.70, Jan 2022-, “Application of space-based lightning detection in power systems”, Convenor: Joan Montanyà (Spain)
- JWG C4_B4.72, “Lightning and Switching Induced Electromagnetic Compatibility (EMC) issues in DC power systems and new emerging power electronics-based DC equipment”, Convenor: Qingmin Li (China)
- JWG B2_C4.76, “Lightning & Grounding Considerations for Overhead Line Rebuilding and Refurbishing Projects, AC and DC”, Convener: William A. Chisholm (CA)

Other Working Groups

- IEEE PES Lightning Performance of Overhead Lines Working Group
  - Annual meeting will be held this year in conjunction with the 2022 IEEE PES GM (which was held in Denver from Jul 17-21).
  - In 2023, the meeting will be held July 16 – 29 in Orlando, FL.

This year's activities

- Organized a Lightning session at GlobalEM that will be held Nov 13-17 in Abu Dhabi, UAE
- Papers submitted to the ICLP conference in Cape Town, to ICAE in Tel Aviv, and to URSI AT-AP-RASC.
- Currently upgrading the Säntis measurement facility to include microwave measurements and UAV measurements
- Taught an advanced Ph.D. level course on lightning physics and measurements

Proposed work for 2023

- Workshop on one aspect of lightning at one of the 2023 events with lightning content
- Contributions to the 2023 events with lightning content

3 August 2022

IEEE EMC Society TC5 Subcommittee: Electromagnetic Information Leakage

Yuichi Hayashi

2022 IEEE INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC COMPATIBILITY, SIGNAL & POWER INTEGRITY
WWW.EMC2022.EMCSS.ORG • #IEEE_ESP22

Special Sessions in IEEE EMC + SIPI 2022

SS-WE-AM1,2-TC5: Hardware Security for Smart Society

Session Organizers: Yuichi Hayashi (Nara Institute Science and Technology, Japan) , Naofumi Homma (Tohoku University, USA), Jong-Gwan Yook (Yonsei University), William Radasky (Metatech Corporation, Goleta, CA, USA)

The number of papers: 6 **papers**

This session is scheduled for the morning of August 3.

1. **Introduction to a Special Session on Hardware Security for Smart Society** (Yuichi Hayashi, Naofumi Homma, Jong-Gwan Yook, William A. Radasky)
2. **On (in) Security of Edge-Based Machine Learning against Electromagnetic Side-Channels** (Shivam Bhasin, Dirmanto Jap, Stjepan Picek)
3. **Learning-Based Denoising Algorithm for the Reconstructed Image Using Electromagnetic Emanations from the Display Device** (Taesik Nam, Dong-Hoon Choi, Eui-Bum Lee, Jong-Gwan Yook)
4. **A Study for Improving Signal-to-Noise Ratio Measurement Method in Side-Channel Information Leakage of Cryptographic Hardware** (Kengo Iokibe, Masaki Himuro, Yoshitaka Toyota)
5. **SASIMI: Evaluation Board for EM Information Leakage from Large Scale Cryptographic Circuits** (Daisuke Fujimoto, Youngwoo Kim, Yuichi Hayashi, Naofumi Homma, Masanori Hashimoto, Takashi Sato, Jean-Luc Danger)
6. **The Technological Arms Race in Hardware Security** (Shahin Tajik, Patrick Schaumont)

Activities in IEEE Digital Privacy Initiative

IEEE Digital Privacy

- Framework and Foundation
- Policies and Legislations
- Conferences and Workshops
- Education and Training
- Publications
- Standards
- Connected Vehicles Industry
- Healthcare Industry
- Energy Industry

The IEEE Digital Privacy Initiative was approved under IEEE Future Directions in January 2022 as an IEEE-wide effort dedicated to champion digital privacy for individuals. The Initiative advocates a user centric perspective – focusing on the digital privacy needs of the individuals rather than the security of data, products, and organizations – such as empowering individuals with user-enabled privacy controls and promoting privacy at the outset of product and service lifecycles.

Participating IEEE OUs

IEEE Biometrics Council; IEEE Computational Intelligence Society; IEEE CTSoc Consumer Technology Society; IEEE Educational Activities; EMC Society IEEE Electromagnetic Compatibility Society; IEEE Electronics Packaging Society; EMB IEEE Engineering in Medicine and Biology Society; IEEE PES Power & Energy Society; IEEE Reliability Society; IEEE SSIT Society on Social Implications of Technology; IEEE SA Standards Association; IEEE Systems Council; IEEE SMC Systems, Man, and Cybernetics Society; IEEE VTS Connecting the Mobile World

Outreach activity in future

To promote the field of information leakage, we would like to have workshop/special sessions in future EMC symposiums.

Special session in EMC Europe 2023 (September 4-8, 2023, Krakow, Poland) or APEMC 2023
Topic: The issues of Electronics Supply Chain Security (tentative)

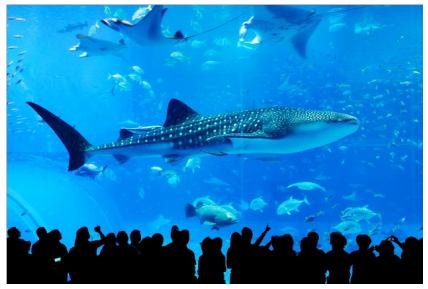
EMC2024 & APEMC2024

First Announcement

APEMC 2024

EMC 2024 Okinawa

Will be held in Japan five years after EMC Sapporo & APEMC 2019



Dates: May 20 -24, 2024
Venue: Okinawa Convention Center (Ginowan), Okinawa, Japan
Call for papers: TBA

HEMP/IEMI Subcommittee Report to TC 5 (HPEM)

Mike McInerney

3 August 2022

TC5 HEMP / IEMI Subcommittee

- Created in 2020 to improve the organization of the website and ease subcommittee reporting
  - HEMP information had been placed only in meeting minutes, while other subcommittees placed relevant information on their respective sub-pages on the website
  - Since parts of HEMP and IEMI have similar fast rising time waveforms and are high power EM, they are associated
  - HEMP (and IEMI) literature is now listed on the HEMP / IEMI web page
  - Mike McInerney volunteered to be the General POC for the new HEMP / IEMI subcommittee
  - Bill Radasky volunteered to be the POC for the new HEMP subcommittee
  - Frank Sabath retired from his role as POC for the IEMI subcommittee, and Sven Fisahn took over

TC5 HEMP / IEMI Subcommittee

- We encourage all TC5 committee members to submit information on TC5 related activities to subcommittee POCs
  - Lightning
  - EM (Information) Leakage
  - HEMP / IEMI
  - ESD

Recent HEMP Activities

Report from the TC5 Subcommittee on HEMP
Compiled by William Radasky

Recent HEMP Activities

- Several important HEMP activities have continued since our last virtual conference and TC5 meeting in 2021
  1. The U.S. Department of Energy has published an open document to specify recommended HEMP waveforms to use to evaluate the vulnerability of the U.S. infrastructure. Many power companies are reacting to this development
  2. The IEC is updating IEC 61000-2-9 (HEMP environment)
  3. The IEEE Power Energy Society is preparing a white paper dealing with the protection of protective relays from HEMP (will publish in 2024)
  4. CIGRE Study Committee C4 has a working group considering approaches to protect high voltage power control house electronics against HEMP
  5. Power companies are investigating ways to protect their electronics from HEMP (and IEMI)
- Items 2 and 5 are discussed in more detail in the following two charts

IEC 61000-2-9 Update Plans - 1

- IEC Subcommittee 77C has started new work and maintenance on its body of IEMI and HEMP publications
  - Several HEMP and IEMI publications are being updated
- For the HEMP radiated environment, there are several areas of IEC 61000-2-9 that have been discussed for more than 2 years to improve the standard
- The maintenance work for IEC 61000-2-9 is underway
  - Project Leader: Dr. William Radasky
  - Summary of improvements are on the next chart

IEC 61000-2-9 Update Plans - 2

- Key improvements to be considered
  - Provide information for the variation of the E1 and E3 HEMP fields as a function of position. This could include sample ground contour plots and/or range dependent variations for the peak values and even the pulse shapes.
  - Consider adding a few additional analytic E1 HEMP waveforms with different rise times and pulse widths.
  - Provide new E3 HEMP waveforms (both B- and E-fields) based on new openly published information.
  - Provide information on how to compute the E3 field from the incident B-field and provide a few ground conductivity profiles for those calculations.
  - Provide an annex that shows an equivalent QEXP (Quotient of Exponentials) waveform that is more accurate above 100 MHz for the E1 HEMP waveform. This will help those who try to extend the DEXP (Difference of Exponentials) waveform in the frequency domain to frequencies well above 1 GHz.
  - Explain in another annex why the E1 HEMP waveform in time does not require a “zero area”. This has caused a great deal of confusion regarding the way the E1 HEMP waveform is specified.
  - Provide (in an annex) a simple explanation of the high-frequency approximation (HFA) so the use of the “1-D” numerical solution is not misunderstood. A comprehensive list of references could also be provided to underscore the accuracy of the HFA.

Power Company Activities

- Over the past 2 years power companies are evaluating the shielding effectiveness of their existing transmission substation buildings
- One company has upgraded a current metal building design to improve its shielding effectiveness
  - Screen mesh windows
  - Better external cable bonding before entry
  - Testing before and after changes to demonstrate improvements

Recent IEMI Activities

Report from the TC5 Subcommittee IEMI
Compiled by Sven Fisahn

Recent IEMI Activities - 1

- 2021 Joint IEEE International Symposium on Electromagnetic Compatibility, Signal & Power Integrity, and EMC Europe 2022 (EMC+SIPI 2021 Virtual)
  - Tutorial chaired by F. Sabath: Modeling of Intentional Electromagnetic Interference (IEMI) Scenarios
  - Workshop chaired by F. Sabath, D. Giri and R. Hoad: HPEM Effects on Electronic Systems
  - Workshop chaired by M. Suhrke and M. Schaarschmidt: Protection of Critical Infrastructure against Intentional Electromagnetic Interference
  - Technical Session chaired by M. McInerney and F. Sabath: IEMI Generators and Modeling
  - Technical Session chaired by F. Sabath and M. McInerney: Intentional EMI and HEMP

Recent IEMI Activities - 2

- Kleinheubacher Tagung 2021 (German forum of U.R.S.I.)
  - Special Session chaired by M. Schaarschmidt and S. Fisahn: Risk Analysis and German activities within MSCA ITN “PETER Pan European Training, Research & Education Network on Electromagnetic Risk Management”
- 2022 IEEE International Symposium on Electromagnetic Compatibility, Signal & Power Integrity (EMC+SIPI 2022 Spokane)
  - Tutorial chaired by F. Sabath and D. Giri: Recent Advancements in HEMP, EMP and IEMI Protection – A global perspective

ESD Update

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Michael Khazhinsky
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TC-5 (HPEM) Meeting

August 3, 2022

ESD Technical Exchange – 2022 Updates

- The 2022 EOS/ESD Symposium again has a special focus on EMC and system-level related topics.
  - Session with 3 papers
  - 4 seminars

- Paper exchange program between IEEE EMC+SIPI Symposium and ESDA continues in 2022.
  - Three papers from 2020 EMC & SIPI Symposium are presented as invited papers at the 2022 EOS/ESD Symposium.
    1. Trend Analysis of Dissipated Electrostatic Discharge Energy in Touchscreen Displays
    2. Analysis Of CPU Loading Effect On ESD Susceptibility
    3. Commercial USB IC Soft-Failure Sensitivity Measurement Method and Trend Analysis

ESDA/IEEE EMC Society Meeting

- ESDA & IEEE EMC society actively cooperate in technical paper exchanges, tutorials, and invited talks.
- Board of Directors of both organizations regularly meet. The last meeting in April, was a surprise as both organizations had their meetings taking place in adjacent rooms of the same hotel in Frisco, TX.
  - Near term plans discussed included ESD session at the 2022 EMC+SIPI Symp. 2022 and special EMC track at the 2022 EOS/ESD Symp. from September 18-23.
  - Long term plans include exploring opportunities for technical committees cooperation on existing and future standards.

In picture (left to right): Vignesh Rajamani, EMC Society President; Nate Peachey, ESDA Senior Vice President; Harald Gossner, ESDA President; Michael Khazhinsky, ESDA Technical Liaison; Lisa Pimpinella, Executive Director at the meeting in Frisco, Texas on April 7, 2022.