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Training The Future Now For Ruggedized Electronics: Why Certification Matters Starting With Radiation Effects

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We stand at a pivotal moment in space and defense microelectronics. The growth rate across the space and defense sectors for ruggedized electronics is outpacing the workforce available to test and qualify the products for usage.

For example, across the United States, between 700 and 1,000+ active job openings sit waiting for qualified radiation effects engineers—a workforce gap that limits progress for satellite and systems developments. From satellites orbiting Earth to next-generation warfighter platforms, every mission-critical microchip must survive the invisible onslaught of cosmic rays, protons, and in some cases nuclear-weapon-induced radiation. Yet the pipeline to train these specialists has been limited for years.

That's where WARPTEN—Workforce Advanced Radiation and Practical Testing of Electronics for Nextgen—enters the picture. Developed by Trusted Strategic Solutions (TSS), leaders in ruggedized electronic advisory support, in partnership with Indiana University's Center for Reliable & Trusted Electronics (IU CREATE), WARPTEN is the first self-sustaining, certification-based training program purpose-built to bridge the chasm between academic theory and real-world ruggedized electronics testing. WARPTEN's initial focus area is space radiation effects. Fig. 1 depicts the objectives of the WARPTEN program and its participants.

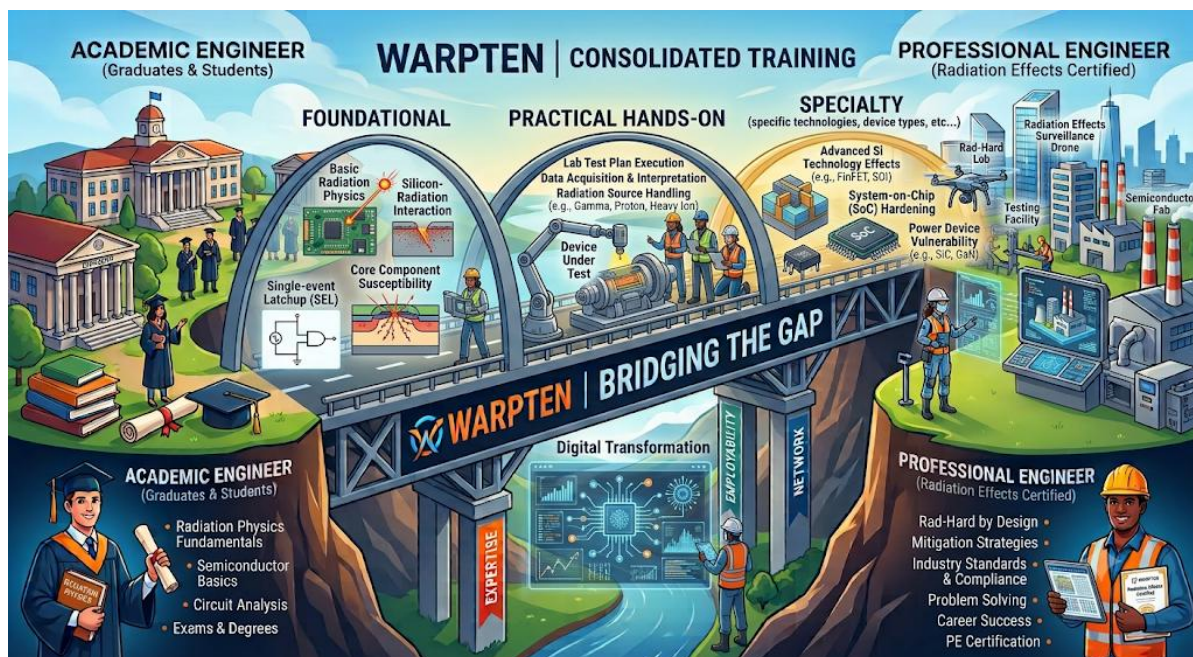


Fig. 1. Without WARPTEN training, graduating students, new entrants into the workforce, and those looking to learn a new skillset are not be prepared for the work needed by industry and government organizations. WARPTEN takes years off the learning curve. Radiation effects example is shown.

Regardless of the market requiring additional screening (space nuclear, environmental, etc.), reliable utilization of microelectronics in the ruggedized environment is critical. Bringing in instructors with practical knowledge built on "been there, done that," shortens the learning development curve for those entering or being retrained in the workforce.

The Workforce Gap Nobody's Talking About

TSS has taken this challenge head on with an initial focus on radiation effects. Demand for radiation effects expertise is concentrated in aerospace, defense, and space sectors—with major hubs in locations such as California, Colorado, Florida, and Maryland.

Because these roles require niche skills in total ionizing dose (TID) and single event effects (SEEs), top companies source nationally. The result? A national shortage of engineers who can walk into a heavy ion beamline and execute a defensible test plan for SEE testing. This is episode one of the WARPTEN mission: filling the gap for critical skills starting with SEE testing. Table 1 lists demands that WARPTEN seeks to address and its structure.

Table 1. Needs addressed by WARPTEN and program structure.

Metric	Value	Notes
Active U.S. job openings	700 to 1,000+	Radiation effects & electronics testing
Primary sectors	Aerospace, defense, space	Commercial space is fastest growing sector
Beam time cost allocation	50%+	Of typical boot camp budget
Certification levels offered	Three	Foundational, Practical, Specialty
Self-sustainment timeline	Three years	Tuition-based operational model

Although WARPTEN is a new program, it is built on older programs with a proven track record. We've seen what works. The Texas A&M University (TAMU) Boot Camps, the Academy for Radiation Effects and Survivability (A4RES), and the SCALE (Scalable Asymmetric Lifecycle Engagement) program each pushed the community forward.

But every one of them ran into the same wall: government funding either dried up or supported only one-off events for practical training. WARPTEN learns from those successes and consolidates them into a single, certifiable, tuition-supported pathway that doesn't collapse the moment a grant cycle ends (Table 2).

Table 2. How WARPTEN augments existing and previous workforce approaches.

	A4RES	TAMU boot camps	SCALE	WARPTEN
Hands-on training		✓		✓
Foundational training	✓	✓	✓	✓
Advanced practical topics training			Limited	✓
Instructor base	All sectors	All sectors	Majority academic	All sectors
Certification with practical curriculum				✓
Self-sustainment				✓
Digital twin/VR-AR				✓

SEE testing, due to the experiences from A4RES and the boot camps, is considered the low-hanging fruit to begin molding the WARPTEN model. The model easily allows expansion to support stakeholder training gaps in related areas. Fig. 2 lists some possible areas in testing, design, manufacturing and management that WARPTEN could address.

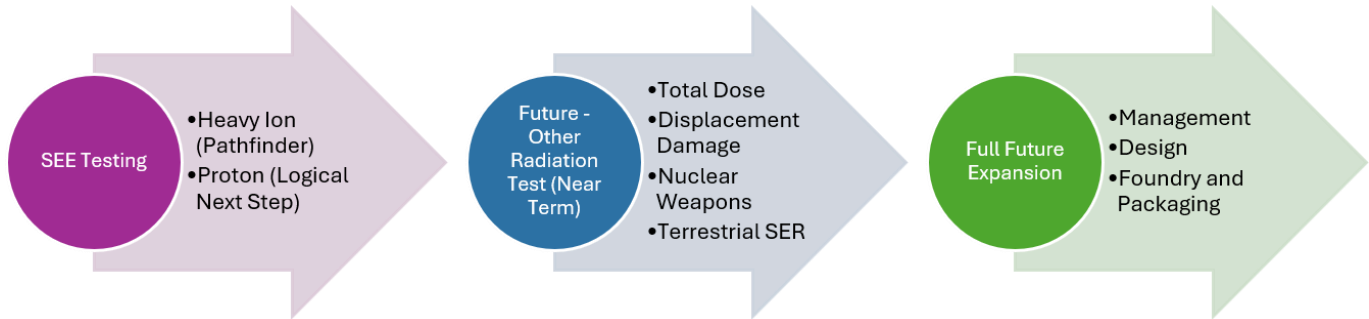


Fig. 2. Potential future path for WARPTEN expansion.

Certification And Instructor Base

Some clarification is needed: to be clear, WARPTEN will be providing an *industrial certification* and not academic credits. However, with our sustainable model, partnered universities may license content and create their own academic credit curriculum (Fig. 3).

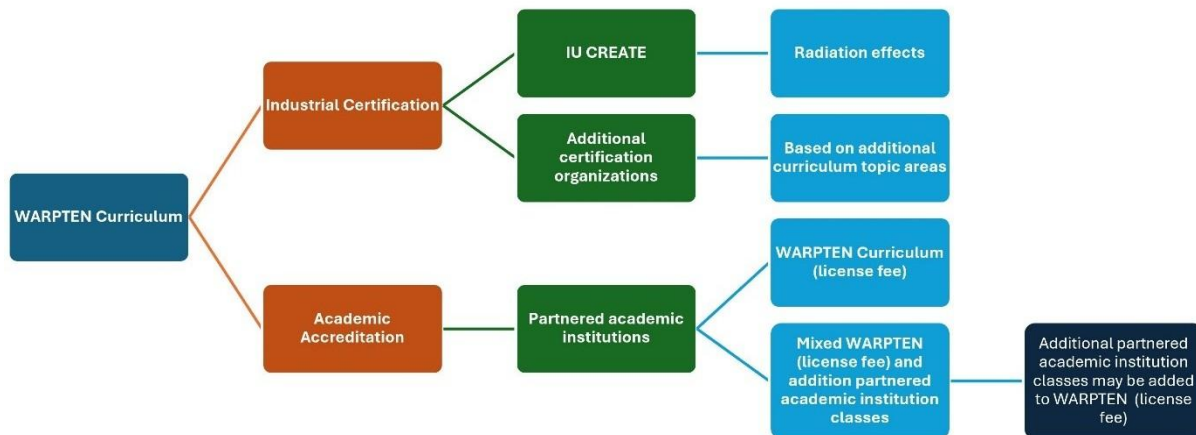


Fig. 3. Flow for providing industrial certification and future academic credits.

WARPTEN will have three levels of certification with a flexible model for participation. These are defined in Fig. 4.

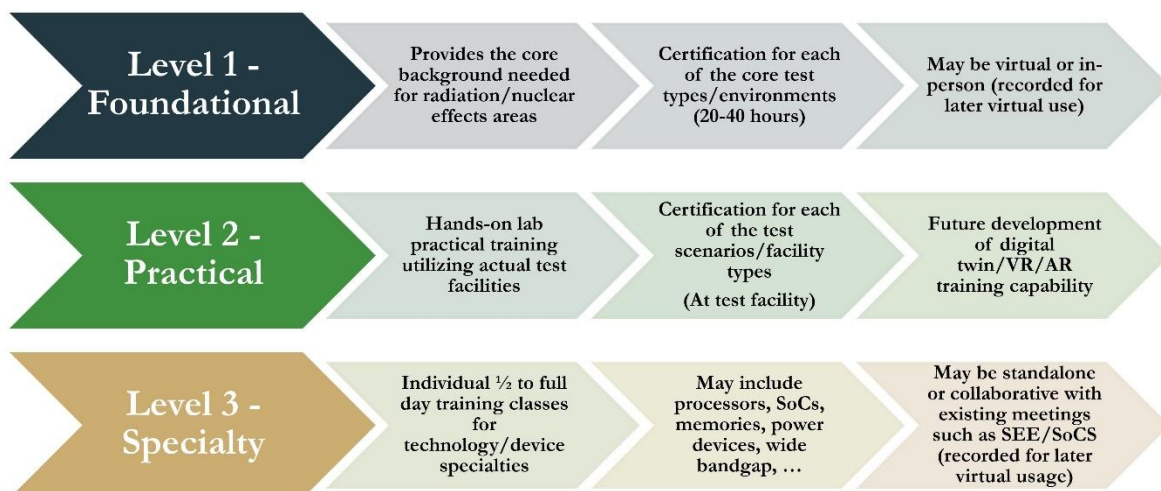


Fig. 4. The three certification levels of WARPTEN.

The Three Pillars Of Community Modernization

WARPTEN doesn't stand alone in TSS's approach to building for the future. We're rolling out a complete radiation community infrastructure alongside two companion platforms that together digitize a field long stuck in analog workflows (Figs. 5 and 6).

- RADWiki—A collaborative wiki for sharing and developing radiation testing guidance, with SME (subject matter expert) approved edits, revision history, and community blog interaction.
- BEAM4SEE—A virtual network connecting users to heavy ion and proton test facilities, complete with real-time availability indicators (red, yellow, green) managed by facility POCs.
- WARPTEN—The certification and training backbone, delivering foundational, practical, and specialty modules across the full radiation ecosystem.

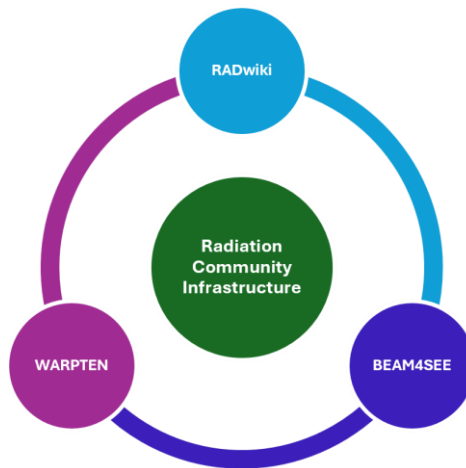


Fig. 5. The TSS approach to modernizing the radiation community infrastructure.

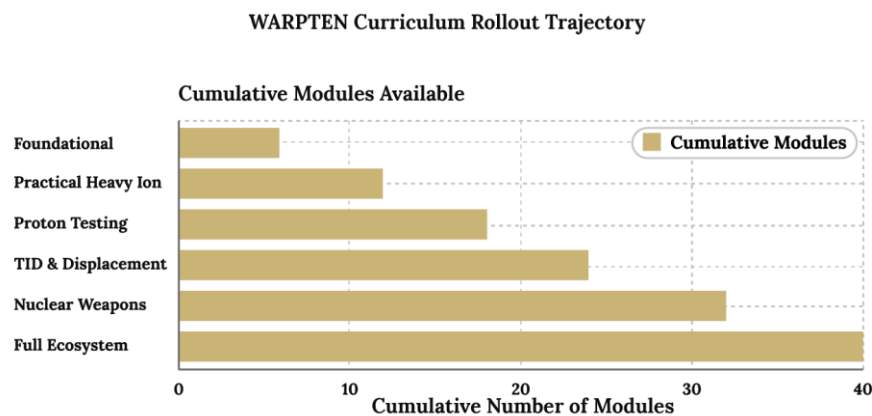


Fig. 6. Notional view of curriculum module increase as new topics are added.

Why Digital Modernization Changes Everything

Beam time is expensive—often exceeding 50% of total boot camp costs—and physical training space limits participation to a handful of engineers per class. By digitally twinning facilities like the NASA Space Radiation Laboratory (NSRL) beamline and layering VR/AR training on top, we can dramatically reduce cost-per-trainee and extend the reach of hands-on instruction to workforce populations that would otherwise never step inside a radiation facility. That's how we scale expertise without scaling risk. This also enables students to not be limited by proximity or access to a particular beam line.

The Sustainable Business Model

Government one-off funding mostly built the past. Tuition-driven sustainability builds the future. WARPTEN's model separates initial non-recurring engineering (NRE)—the Learning Management System, digital twin pathfinder, and core SEE curriculum—from ongoing operational tuition segments funded by participants and their organizations. Fig. 7 offers a view of the initial concepts for financing WARPTEN training.

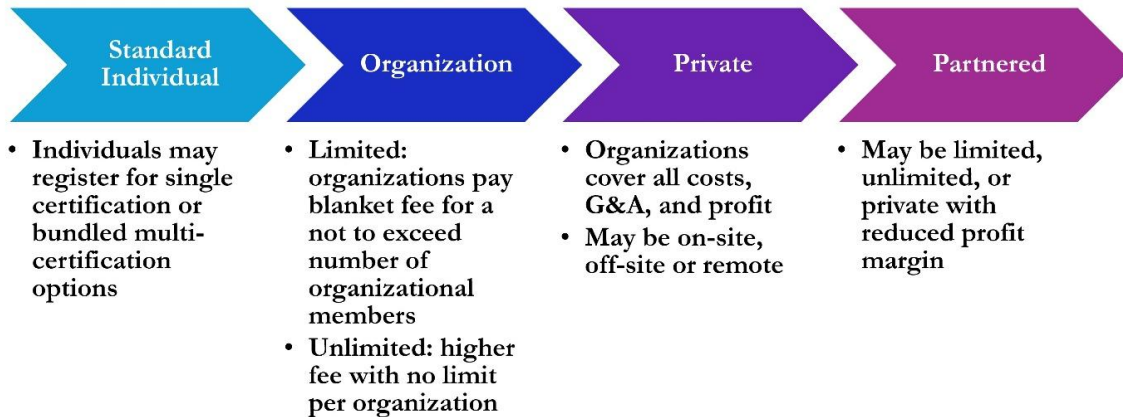


Fig. 7. Preliminary tuition fee concepts.

In developing WARPTEN, we've drawn inspiration from the U.S. Particle Accelerator School (USPAS), where volunteer experts from industry, government, and academia rotate through teaching assignments. Our curriculum isn't stitched together from recycled slide decks—every module is purpose-built by acknowledged subject matter experts and peer-reviewed by the tri-sector community. It's the right person, teaching the right topic, for the right reason.

The plan is to utilize experts who have spent their careers at agencies such as NASA and JPL developing the skills and knowledge needed to keep up with the consistent changes to technology, testing methodologies and programmatic requirements.

Where We Go From Here

The SEE Symposium tutorials, an initial WARPTEN collaboration, in 2026 were extraordinarily well received, and all recorded material now lives in the WARPTEN library. Verbal agreements are in place with all four domestic heavy ion test sites. NRE quotes are locked in for the LMS and initial digital twin build. What we need next is partnership—additional NRE sponsors, industry-recognized expert volunteer instructors, beam-time underwriters, and collaborative certification stakeholders willing to bet on the next generation.

The Defense Common Parts Testing (DeCPTR) program, individual agencies, and industry consortia are all natural targets for this collaboration. Because at the end of the day, microelectronics is foundational to every civil, commercial, and defense technology—and the workforce that qualifies those chips is foundational to microelectronics.

WARPTEN is moving forward at maximum warp. Whether you're an academic institution, a defense prime, a small business, or a federal agency, there's a role for you in this ecosystem. Reach out to Trusted Strategic Solutions^[1] or contact the authors^[2] to explore curriculum development, instructor volunteering, beam-time sponsorship, or collaborative certification pathways.

We need your support to be successful. The next generation of warfighter electronics depends on the workforce we train today.

References

1. Trusted Strategic Solutions (TSS) [website](https://www.trustedstrategicsolutions.com/).
2. For more information on WARPTEN, contact the authors via email at dmarrujo@tss.llc and klabel@tss.llc. For more on IU CREATE, contact Daniel Loveless at dlovele@iu.edu.

About The Authors



Kenneth A. LaBel is currently a technical lead with Trusted Strategic Solutions (TSS), as well as the Johns Hopkins University Applied Physics Laboratory, and Columbus Technologies. In January 2019, he retired from NASA where he was the program manager of the NASA Electronic Parts and Packaging (NEPP) program for 15 years and group leader for the Radiation Effects and Analysis Group (REAG) at NASA GSFC.

Over 40 years, LaBel supported NASA and other government agencies in the fields of space/military electronics and radiation effects. At NASA he received awards such as NASA/Goddard Moe I. Schneebaum (top engineer), QASAR (Quality Assurance Safety and Reliability), NASA National Resource, NASA Honor Award, and NASA Exceptional Service Medal. He also received the IEEE NPSS Radiation Effects Award 2023 and the HEART Society Peter Haas Award 2024.

LaBel has published over 200 papers; taught multiple short courses and given multiple invited talks at international and domestic venues. In addition, he has taken active leadership roles in conferences for IEEE, HEART, RADECS and others including as 2009 IEEE NSREC Short Course chair, 2012 IEEE NSREC Conference chair, 2018 RADECS Topical Day chair, and 2025 RADECS Short Course co-chair.

LaBel has also supported multiple workforce development activities including Radiation Effects Boot Camps, the Academy for Radiation Effects and Survivability (A4RES), and the new Workforce Advanced Radiation and Practical Testing of Electronics for Nextgen (WARPTEN). He holds a BES in EECS with a minor in mathematical sciences.



Daniel Marrujo is the president and managing director of Trusted Strategic Solutions, a Silicon Valley-based consulting and government relations firm focused on national security, microelectronics, and strategic technology initiatives. He serves on the board of advisors for BMNT, the Midwest Microelectronics Consortium (MMEC), and Silicon Catalyst Angels. He also serves on the board of directors for the Greater Sacramento Economic Council (GSEC) and is a member of the President's Council of Advisors for California Polytechnic State University.

In addition, he is a senior fellow at the Potomac Institute for Policy Studies. Prior to entering the private sector, Marrujo served for more than a decade as a senior civilian in the U.S. Government. His final assignment was as chief strategy officer and director of the Office of Research and Technology Applications (ORTA) at the Defense Microelectronics Activity. In this role, he helped lead strategic initiatives supporting the Department of Defense, U.S. Government agencies, industry partners, and allied nations across critical microelectronics efforts.

Marrujo is also the host of the award-winning Micro Journeys podcast and media channel and has been featured by major media outlets, including Apple News and Fox Business. Outside of the technology sector, Marrujo co-founded Trusted American Insurance Agency and is also the co-founder of The Marrujo Foundation, an organization dedicated to advancing research and educational opportunities in astronomy, astrophysics, and cosmology.

Marrujo holds a master of science in materials engineering, a bachelor of science in electrical engineering and a minor in physics from California Polytechnic State University.

For more on radiation effects, see [How2Power.com's Space Power section](#).