

insights

from the land down under

THE 1959 MOTION PICTURE, *ON the Beach*, starring Gregory Peck and Ava Gardner, tells the apocalyptic story of a submarine stationed in Australia. Due to its Southern Hemisphere remoteness, the continent is one of the few places left to succumb to the fallout from a catastrophic nuclear battle. The situation is bleak, and the tale gets bleaker. Mankind's character for hope and survival plays large in the story.

Like *On the Beach*, this issue of *IEEE Power & Energy Magazine* is set in Australia. Back then, the existential driver was the nuclear arms race and the possibility of planned or accidental annihilation. Although that threat remains, another is transforming the energy industry and electric power systems. The driver is climate change and the related efforts to reduce greenhouse gas emissions.

Significant investments in alternative generation sources are dramatically changing the dynamics of operating the Australian grids. Higher penetrations of variable renewable resources and inverter-based resources (IBRs), such as batteries, are necessary to reach the regional emission goals. The changes that Australia is experiencing, and their plans to further reduce emissions, resonate with the transformations occurring in other parts of the world.

What makes Australia unique is its large, electrically isolated area composed of two regionally controlled

grids with local and overarching government policies. Although the issues are complex, Australia presents a microcosm for looking at a variety of dimensions where the energy transformation is occurring arguably more quickly. The diversity of issues covers the operation and planning of the power grids, their market coordination mechanisms, and the government policy and regulatory structures put in place to guide change and the interactions of the constituents.

In This Issue

Six excellent articles, representing early successes, remaining challenges, and ongoing efforts, provide a broad perspective of Australia's power system transformation.

- ✓ "Achieving World-Leading Penetration of Renewables": This article addresses the primary question of how much wind and solar energy can be integrated into the current, large synchronous power system serving Australia's south and east coasts. Grid-operating conditions are presented for near-term future scenarios of ever-higher renewable generation, including significant growth in distributed solar beyond currently world-leading levels. The zones of operation leading to considerable system impact are determined.
- ✓ "Essential System Services Reform": The transition of the power system reopens discus-
- sion of the needs and acquisition of essential system services. This article comprehensively defines the essential system services requirements and presents the strategies for procuring them.
- ✓ "Power System Operation With a High Share of Inverter-Based Resources": The authors detail the challenges of decreasing system inertia and system strength as higher levels of IBRs enter the market. They discuss the current management techniques being used to mitigate contingency impacts and ensure grid frequency performance.
- ✓ "Renewable Energy Zones in Australia": This article presents the results of an analysis- and stakeholder-driven process to determine the locations within Australia where renewable energy can be most efficiently integrated. It details the impact these resource scenarios have on power system resilience and the benefit of the integrated system plan beyond traditional network upgrades.
- ✓ "From Security to Resilience": The authors tackle the challenge of addressing high-impact, low-probability events in low-carbon grids. The risk of such events, the uncertainties in system operating conditions (which make these events difficult to predict), and the impact of these events on system

resilience are detailed. Ideas are presented for new mechanisms to manage operating risks and realize increased resilience.

- ✓ “Distributed Energy Resources Roadmap”: This article focuses on the operation of Australia’s South West Interconnected System, given the continually higher levels of installed distributed energy resources. The article discusses technical operating issues and customer education efforts. The need for a broad and comprehensive “buy-in” by all stakeholders to successfully plan long-term grid transitions is emphasized. A use case for the community-level microgrid integration of distributed energy resources is also presented for one of Australia’s many isolated grid systems.

- ✓ “In My View”: This column provides a perspective of Australia’s energy transition over the past five years. It presents five universal features for transitioning to a low-carbon power system.

Homage

As the July/August issue of *IEEE Power & Energy Magazine* was being prepared for press, we learned of the death of Mike Henderson, my predecessor and mentor as editor-in-chief. Fellow editors and his longtime friends Mel Olken and John Paserba remember him in the “Society News” column.


Henderson and I were contemporaries in the power field. Coincidentally, we both started working at American Electric Power Service Corporation in Manhattan as entry-level engineers. New York memories would make for a

common bond as we met at IEEE Power & Energy Society (PES) meetings and attended panels that the other chaired. He arranged his panels as performances: developing an interesting theme, assembling talented speakers, structuring complementary contributions, and communicating take-away messages. He brought the same focus-on-the-audience persona to the regional transmission planning sessions he chaired for ISO New England, and importantly, to this magazine. He left the stage too soon. Although he can no longer answer my calls, his voice reverberates.

Message From the PES Past President

A message from Saifur Rahman graces this issue’s “Leader’s Corner” column. The climate change issues that are


Application Highlight: Australian TSOs have adopted SSAT for grid oscillation studies




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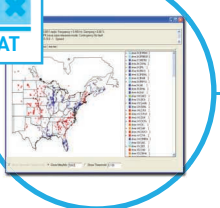
Modeling of renewables and their controls in DSATools™


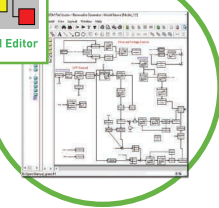
- Advanced time-domain simulation (TSAT) and eigenvalue analysis (SSAT) tools for studies including renewable integration and power grid oscillations
- Supporting latest generic models for dynamic simulations
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Experience and support

- Provider of co-simulation platforms to perform TSA-EMT hybrid studies with TSAT & PSCAD™ or TSAT & RTDS™
- Consulting services for
 - Custom model development
 - Generic model validation/tuning (NERC MOD 26/27)
 - Studying the impact of high penetration of renewables

transforming the power and energy industry present not only challenges but opportunities to contribute ideas and seek solutions. PES provides a strong platform for communicating challenges and potential solutions. Opportunity calls to grow our diverse and talented membership and provide leadership in the discussion and shape of solutions.

Book Review

While we take a break from the “History” column in this issue, Editorial Board Member Brian Johnson provides a review of the textbook *Power Systems Modelling and Fault Analysis: Theory and Practice*, second edition, by Nasser Tleis. This technical area calls for a new look as the deployment of equipment and control techniques of IBRs grow and modern fault-analysis methodology and tools expand.

Cue the Spotlights

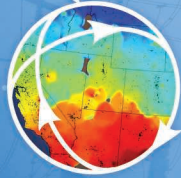
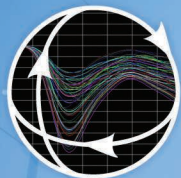
IEEE announced the 2021 award recipients. Those awards related to PES, including the IEEE Medal in Power Engineering, the PES-related technical field awards, and the Society-level awards, are presented in the “Awards” column. Please congratulate this year’s awardees for their exceptional achievements.

The Ending

We applaud Guest Editor Dean Sharafi on his directorial debut of arranging the feature articles for this issue. We also thank the many authors who created the articles and interacted with our talented editorial staff, Associate Editor Barry Mather and Assistant Editor Susan O’Bryan, and who worked with Geri Krolin-Taylor and IEEE Publishing to develop the finished product in your hands.

Although this issue takes a slight departure from the magazine’s regional diversity intentions by featuring stories and examples set in Australia, we believe the challenges, experiences, and conversations about the transformation underway in Australia’s two main power grids have global ramifications.

The desired reaction of *On the Beach* was to startle the audience with the serious consequences from nuclear confrontation. In today’s vernacular, one might say *woke*. Whether startled or woke, may the challenges and potential directions addressed in these articles bring hope to realizing an energy posture appropriate to the existential threat before us. Take heed, as the Salvation Army banner over the empty Melbourne city street at the film’s end announces, “There Is Still Time..Brother.”



WHAT DO YOU WANT TO DO?

Calculate **geomagnetically induced currents** for entire interconnects?

Write your own code in **Python** or other languages to access PowerWorld through an API?

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Use an intuitive **transient stability** tool that natively supports the **most models** in the industry?

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