IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 14, May 2023

Internal Support Optimization of Cryolines in Terms of Heat Load and Pressure Thrust Using Finite Element Methods

Hardik V. Talati[1] and Dr. Saurabh Dikshit[2]
Student, Department of Mechanical Engineering (CAD/CAM)[1]
Professor, Department of Mechanical Engineering[2]
Government Engineering College, Dahod, India

Abstract: *Almost all cryogenic systems typically include cryogenic transfer lines. They serve the purpose of moving cryogenic fluids between two cryogenic equipment. One of the most crucial components of the cryoline is the fixed support (FS), which also serves as the anchor for the bellows. The FS must be able to handle the static weight of pipes as well as the bellows' spring and thrust forces. For the thermal, structural, and combined loads with thermal optimization criteria, the FS design will be optimized. ANSYS Software will be used for the analysis and Space Claim Software will be used for the modelling as well as geometry optimization. A thorough mesh sensitivity investigation and design optimization will be done in order to reduce the Von-Mises stress to within the material's permissible range. Mesh refinement continued iteratively until stress convergence will be attained. For the best mesh size a stress analysis will be done. The design process, construction information, and the outcomes of the heat load optimization using the steady state thermal module and the strength optimization using the static structural module of ANSYS will be presented in this study.*

Keywords: Deformation Profile, Fixed Spacer, Finite Element Method (FEM), ANSYS

REFERENCES

[1]. Anup kumar Dey, in Caesar – II, Piping stress analysis, piping stress basics Design and Stress Analysis of Jacketed Piping System. https://whatispiping.com/jacketed-piping-system

[2]. Shah, N. D., Bhattacharya, R. N., Sarkar, B., Badgujar, S., Vaghela, H., & Patel, P. (2012, June). Preliminary system design and analysis of an optimized infrastructure for ITER prototype cryoline test. In *AIP Conference Proceedings* (Vol. 1434, No. 1, pp. 1935-1942). American Institute of Physics.

[3]. Sarkar, B., Badgujar, S., Vaghela, H., Shah, N., Bhattacharya, R., & Chakrapani, C. (2008, March). Design, analysis and test concept for prototype cryoline of ITER. In *AIP Conference Proceedings* (Vol. 985, No. 1, pp. 1716-1723). American Institute of Physics.

[4]. Sarkar, B., Shah, N., Vaghela, H., Bhattacharya, R., Choukekar, K., Patel, P., ... & Chalifour, M. (2015, November). Value Engineering in System of Cryoline and Cryo-distribution for ITER: In-kind Contribution from India. In *IOP Conference Series: Materials Science and Engineering* (Vol. 101, No. 1, p. 012036). IOP Publishing.

[5]. Badgujar, S., Benkheira, L., Chalifour, M., Forgeas, A., Shah, N., Vaghela, H., & Sarkar, B. (2015, November). Loads specification and embedded plate definition for the ITER cryoline system. In *IOP Conference Series: Materials Science and Engineering* (Vol. 101, No. 1, p. 012035). IOP Publishing.

[6]. Kapoor, H., Garg, A., Shah, N., Muralidhara, S., Choukekar, K., Dash, B., ... & Panjwani, R. (2017, February). Acceptance tests and their results for 1st Pre-Series Cryoline (PTCL) of ITER. In *IOP Conference Series: Materials Science and Engineering* (Vol. 171, No. 1, p. 012054). IOP Publishing.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 14, May 2023

[7]. Sarkar, B., Vaghela, H., Shah, N., Bhattacharya, R., Choukekar, K., Patel, P., ... & Monneret, E. (2017, February). Status of ITER Cryodistribution and Cryoline project. In *IOP Conference Series: Materials Science and Engineering* (Vol. 171, No. 1, p. 012057). IOP Publishing.

[8]. Badgujar, S., Vaghela, H., Shah, N., Bhattacharya, R., & Sarkar, B. (2009). Evolution of thermal shield for ITER torus & cryostat cryoline. *Indian Journal of Cryogenics*, *34*, 95-100.

[9]. Shah, N., Choukekar, K., Kapoor, H., Muralidhara, S., Garg, A., Kumar, U., ... & Cadeau, P. (2017, December). Cold test and performance evaluation of prototype cryoline-X. In *IOP Conference Series: Materials Science and Engineering* (Vol. 278, No. 1, p. 012015). IOP Publishing.

[10]. Badgujar, S., Shah, N., Forgeas, A., Navion-Maillot, N., Monneret, E., Grillot, D., ... & Sarkar, B. (2017, February). Assembly Installation studies for the ITER cryoline system. In *IOP Conference Series: Materials Science and Engineering* (Vol. 171, No. 1, p. 012051). IOP Publishing.

[11]. Badgujar, S., Vaghela, H., Shah, N., Bhattacharya, R., & Sarkar, B. (2010, February). Mesh sensitivity study and optimization of fixed support for ITER torus and cryostat cryoline. In *Journal of Physics: Conference Series* (Vol. 208, No. 1, p. 012010). IOP Publishing.

[12]. Shah, N. D., Sarkar, B., Choukekar, K., Bhattacharya, R., & Kumar, U. (2014, January). Investigation of various methods for heat load measurement of ITER prototype cryoline. In *AIP Conference Proceedings* (Vol. 1573, No. 1, pp. 856-863). American Institute of Physics.

[13]. Ketan, C., Ritendra, B., Nitin, S., Muralidhara, S., Himanshu, K., Pratik, P., ... & Biswanath, S. (2015). Development in design of test infrastructure for ITER prototype cryoline test.

[14]. Badgujar, S., Naik, H. B., & Sarkar, B. Conceptual Design of Large Cryoline for Fusion Reactor. In *at this conference*.

[15]. Badgujar, S., Kosek, J., Grillot, D., Forgeas, A., Sarkar, B., Shah, N., ... & Chang, H. S. (2017, December). Dynamic simulation of relief line during loss of insulation vacuum of the ITER cryoline. In *IOP Conference Series: Materials Science and Engineering* (Vol. 278, No. 1, p. 012105). IOP Publishing.

[16]. Bhattacharya, R., Shah, N., Badgujar, S., & Sarkar, B. (2012). Cryogenic distribution system for ITER Prototype Cryoline Test.

[17]. Ketan, C., Himanshu, K., Muralidhara, S., Nitin, S., Anuj, G., & Biswanath, S. (2016). Performance assessment of the test facility for pre-series cryoline of ITER.

[18]. Kalinin, V., Tada, E., Millet, F., & Shatil, N. (2006). ITER cryogenic system. Fusion Engineering and Design, 81(23-24), 2589-2595.

[19]. .eejo, P. P., Sardhara, R., Bhattacharya, R. N., & Garg, A. Development and Performance Evaluation of Supervisory Control for Proto-Type Cryoline Test Facility using CODAC Core System.

[20]. Kumar, U., Choukekar, K., Jadon, M., Vaghela, H., Kapoor, H., Garg, A., ... & Panjwani, R. (2020). Numerical and experimental investigation of 80K thermal shield assembly of 1st Pre-Series Cryoline (PTCL) of ITER cryolines.

[21]. Bonne, F., Hoa, C., Le Coz, Q., Zani, L., Lacroix, B., & Poncet, J. M. (2019). Optimization of the cooling capacity of the cryo-magnetic system for EU DEMO at the pre-conceptual design phase. Fusion Engineering and Design, 146, 2504-2508.

BIOGRAPHICAL NOTES

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 14, May 2023

Hardik V. Talati Born in the Vadodara in India. He Graduted From Neotech Institute of Engineering, Vadodara in 2021 and Student of ME CAD/CAM of Government Engineering college, Dahod. His Areas of Interest are Design Manufacturing.

Dr. Saurabh B. Dikshit currently working as a Assistant professor in the Department of Mechanical Engineering at Government Engineering Dahod under the Gujarar Technological University. His areas of Interest Thermal and Fluid Science, Turbomachhines.