

50th Annual Report 2019-2020

THE AUTOMOTIVE RESEARCH ASSOCIATION OF INDIA

ARAI
Progress through Research

*Take care of the Earth
She will take care of you...*



ARAI Vision and Mission

Vision

ARAI has a strong base of state-of-the-art technology equipment, laboratory facilities and highly qualified and experienced personnel. With these assets, ARAI has goals, strategies and action plans to achieve fullest customer satisfaction. These are:-

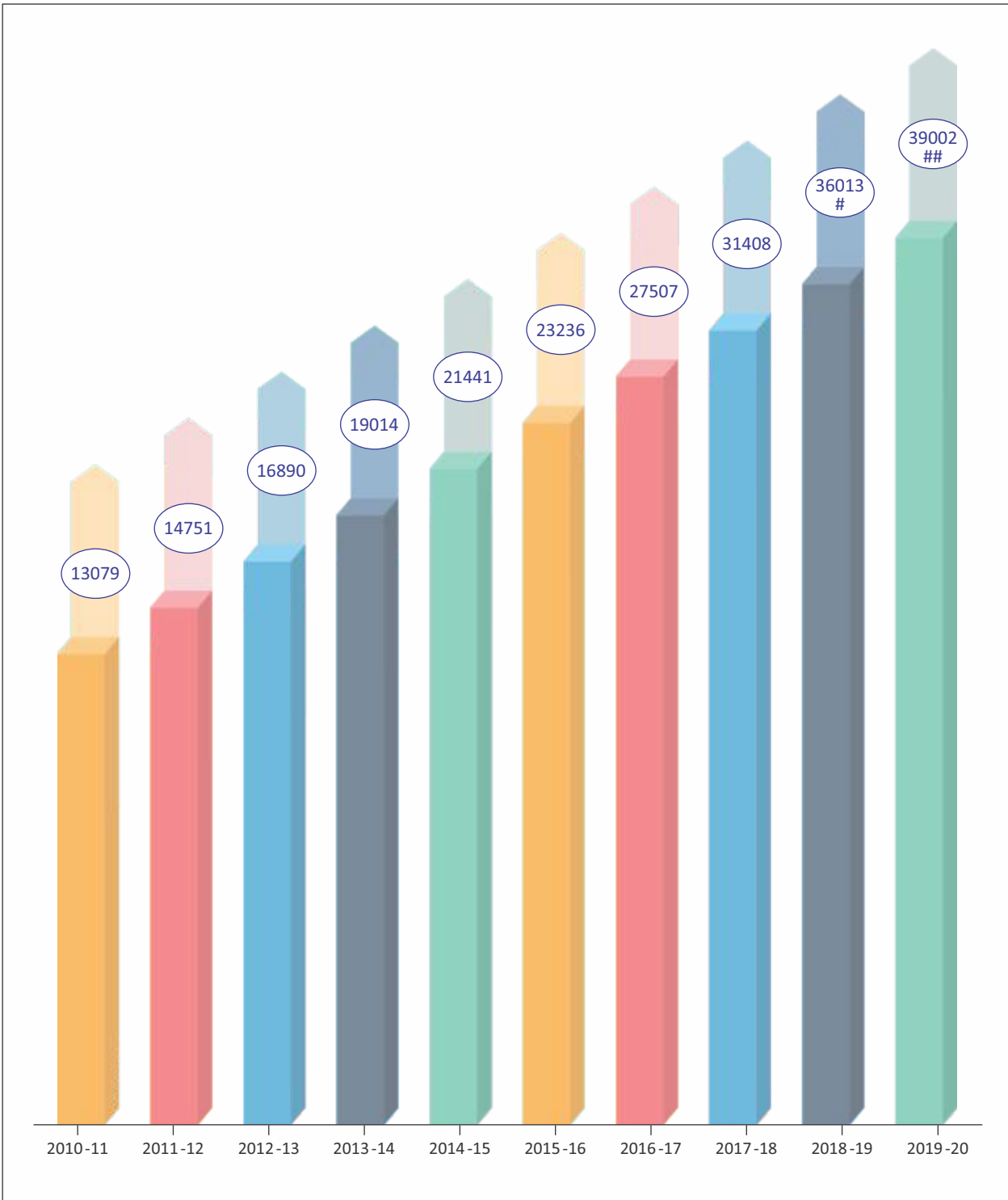
- (a) to compete in service with excellence
- (b) to obtain recognition and accreditation
- (c) to cover global market
- (d) to build commitment of all personnel
- (e) to develop team spirit and sense of belonging amongst all.

Mission

- ARAI has been providing various services to the Indian Automotive Industry in the areas of design and development and know-how for manufacture and testing of components / systems according to national / international standards. ARAI shall strive to achieve international recognition in these areas.
- ARAI shall seek valuable guidance and support from our members, from time to time, to achieve growth and stability.
- With the globalization of economy and business, ARAI shall enlarge its scope of services to meet the requirements of automotive industry-worldwide.
- ARAI strongly believes that satisfaction of customer needs on continuing basis, is of prime importance to earn loyalty of customers. Therefore, emphasis shall be on meeting and exceeding customer needs through continuing quality improvement with active participation of employees and also customers.

Total Income

(Rs. in lakh)



Above Income is excluding Interest on earmarked fund transferred to respective fund and funds transferred from R & D reserve fund.

Excluding Interest on earmarked fund i.e. Rs. 2075 lakh and fund transferred from R & D reserve fund i.e. Rs. 111 Lakh.

Excluding Interest on earmarked fund i.e. Rs. 2711 lakh and fund transferred from R & D reserve fund i.e. Rs. 162 Lakh.

Highlights of the Year

- ☑ Over 14% growth in Operational Income over last year
- ☑ Recognized by 'Telecommunication Engineering Centre', Department of Telecommunications as "Conformity Assessment Body" for testing of telecommunications related products
- ☑ Centre for Green Mobility at ARAI – Homologation and Technology Centre (ARAI – HTC), Chakan inaugurated by Shri Arjun Ram Meghwal, Hon'ble Minister of State, Ministry of Heavy Industries and Public Enterprises
- ☑ Milestone of 500 crash tests at ARAI – Homologation and Technology Centre (ARAI – HTC), Chakan surpassed during the year
- ☑ E-Lite – Electric Bus Development: A Conventional Bus with Internal Combustion Engine (Diesel Powertrain) has been converted to Electric propulsion
- ☑ Development of Mobile Energy Storage Device for 2 & 3 Wheeler EVs
- ☑ ARAI conferred with 'Global Sustainability Award 2019' in Gold Category by Energy and Environment Foundation
- ☑ ARAI conferred with Green Technology Award 2020 by ETNow for contribution towards adoption of EV Technology
- ☑ Mrs. Rashmi Urdhwarshie, Director – ARAI conferred with Nari Shakti Puraskar – 2019 at the hands of Hon'ble President, Shri Ram Nath Kovind and Business Leader of the Year Award 2020 by ETNow



Energy and Environment Foundation's Global Sustainability Award 2019 to ARAI



Nari Shakti Puraskar – 2019 to Director – ARAI at the hands of Hon'ble President, Shri Ram Nath Kovind

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Governing Council

PRESIDENT	: Mr. C. V. Raman, Senior Executive Director-Engineering, Maruti Suzuki India Ltd.
VICE PRESIDENT	: Mr. Rajendra M. Petkar, President & Chief Technology Officer (ERC), Tata Motors Ltd.
DIRECTOR	: Mrs. Rashmi Urdhwareshe

MEMBERS

1. Ashok Leyland Ltd.	9. Honda Cars India Ltd.	17. Tata Cummins Pvt. Ltd.
2. Bosch Ltd.	10. Hyundai Motor India Ltd.	18. Tata Motors Ltd.
3. Cummins India Ltd.	11. JCBL Ltd.	19. Toyota Kirloskar Motor Pvt. Ltd.
4. Cummins Technologies India Pvt. Ltd.	12. Kirloskar Oil Engines Ltd.	20. Tractors and Farm Equipment Ltd.
5. Delphi-TVS Diesel Systems Ltd.	13. Mahindra & Mahindra Ltd.	21. TVS Motor Co. Ltd.
6. Eicher Motors Ltd.	14. Maruti Suzuki India Ltd.	22. VE Commercial Vehicles Ltd.
7. Fiat India Automobiles Pvt. Ltd.	15. Mercedes-Benz India Pvt. Ltd.	23. Volvo Group India Private Ltd.
8. Force Motors Ltd.	16. Skoda Auto Volkswagen India Pvt. Ltd.	24. Wheels India Ltd.

GOVT. OF INDIA REPRESENTATIVES

Mr. Shashank Priya,
Additional Secretary & Financial Adviser,
Govt of India
Ministry of Heavy Industries & Public Enterprises
Department of Heavy Industry
Udyog Bhavan, New Delhi 110 011

Mr Pravin Agarwal
Joint Secretary
Govt of India
Ministry of Heavy Industries & Public Enterprises
Department of Heavy Industry
Udyog Bhavan, New Delhi 110 011

Mr. R. K. Jaiswal,
Development Officer, (Engineering)
Govt of India
Ministry of Heavy Industries & Public Enterprises
Department of Heavy Industry
Udyog Bhavan, New Delhi 110 011

INVITEES

- Society of Indian Automobile Manufacturers
- Automotive Component Manufacturers Association of India
- Tractor Manufacturers Association
- National Automotive Testing and R&D Infrastructure Project

SECRETARY TO THE GOVERNING COUNCIL

Mrs. Prajakta M. Dhere

OFFICE ADDRESS

Survey No. 102, Vetal Hill
Off Paud Road, Kothrud
Pune 411 038, INDIA
Phone : 91-20-3023 1111, 3023 1200
Fax : 91-20-3023 1104
Email: director@araiindia.com

BANKERS

Bank of Baroda
HDFC Bank Ltd

STATUS OF INSTITUTE

Registered under The Societies Registration Act,
XXI of 1860 Regn. No. 133/66 GBBSD dated 10-12-1966
New Regn.No. Maha/2066/2016/Pune dated 13-12-2016
Registered under The Maharashtra Public Trust Act, 1950
Reg. No. F-48091/Pune dated 13-12-2016

AUDITORS

M/s. Gunwani and Kolapkar
Chartered Accountants

Mumbai Office:

602, Pooja 7th Road, Golibar
Santacruz (East) Mumbai - 400055

Pune Office:

206, 4th Dimension, Above Hotel Manali,
Pathwardhan Baug, Erandwane, Pune - 411 038

Members

1. A Raymond Fastners India Pvt. Ltd.
2. Adient India Private Ltd. (Formerly Johnson Controls Automotive Ltd)
3. Aargee Equipments Pvt. Ltd.
4. Ampere Vehicles Pvt. Ltd.
5. Ashok Leyland Ltd.
6. Atul Auto Ltd.
7. A. J. Auto Pvt. Ltd.
8. Bajaj Auto Ltd.
9. Behr-Hella Thermocontrol (India) Pvt. Ltd.
10. BEML Ltd.
11. BMW India Pvt. Ltd.
12. Bharat Forge Ltd.
13. Bharat Seats Ltd.
14. Bosch Limited
15. Brakes India Pvt. Ltd.
16. Chemito Infotech Pvt. Ltd.
17. Cooper Corporation Pvt. Ltd.
18. Cummins India Ltd.
19. Cummins Technologies India Pvt. Ltd.
20. Daimler India Commercial Vehicles Pvt. Ltd.
21. Delphi-TVS Diesel Systems Ltd.
22. DSK Motowheels Pvt. Ltd. ~
23. Eicher Motors Ltd.
24. Enginetech Systems Pvt. Ltd.
25. Faurecia Automotive Seating India Pvt. Ltd.
26. FCA India Automobiles Pvt. Ltd.
27. Fiat India Automobiles Pvt. Ltd.
28. Force Motors Ltd.
29. Ford India Pvt. Ltd.
30. F P Seating Systems Pvt. Ltd.
31. Greaves Cotton Ltd.
32. Gromax Agri Equipment Ltd. (Formerly Mahindra Gujarat Tractor Ltd).
33. Hero Electric Vehicles Pvt. Ltd.
34. Honda Cars India Ltd.
35. Hyundai Motor India Ltd.
36. India Japan Lighting Pvt. Ltd.
37. India Kawasaki Motors Pvt. Ltd.
38. JCBL Ltd.
39. Kanda Auto Pvt. Ltd.
40. Kirloskar Oil Engines Ltd.
41. Kohler Power India Private Limited (Formerly Lombardini India Pvt. Ltd.)
42. KPIT Technologies Ltd. ~
43. KSS Abhishek Safety Systems Pvt. Ltd. ~
44. Lear Automotive India Pvt. Ltd.
45. Madras Engineering Industries Pvt. Ltd.
46. Mahindra & Mahindra Ltd.
47. Mahindra Heavy Engines Ltd.
48. Mahindra Electric Mobility Ltd. (Formerly Mahindra Reva Electric Vehicles Pvt. Ltd.)
49. Man Trucks India Pvt Ltd ~
50. Mansons International Pvt. Ltd. (Formerly Manson Automotive Rubber Pvt Ltd.) ~
51. Maruti Suzuki India Ltd.
52. Masstrans Technologies Pvt. Ltd. (Formerly Power Electronics)
53. Mercedes-Benz India Pvt. Ltd.
54. Minda Rinder India Ltd. ~
55. MLR Auto Ltd.
56. MSKH Seating Systems India (P) Ltd.
57. Piaggio Vehicles Pvt. Ltd.
58. P. M. Diesels Pvt. Ltd.
59. Randhawa Automobile Engineering Pvt. Ltd.
60. Rocket Engineering Corporation Pvt. Ltd.
61. Rohan BRC Gas Equipment Pvt. Ltd. ~
62. Rotary Electronics Pvt. Ltd.
63. Simpson & Co. Ltd.
64. Skoda Auto Volkswagen India Pvt. Ltd. (Formerly Volkswagen India Pvt. Ltd.) (Merger of Skoda Auto India Pvt. Ltd. & Volkswagen Group Sales India Pvt. Ltd. in the new company.)
65. S. M. Auto Engineering Pvt. Ltd.
66. SML Isuzu Ltd.
67. Spaco Technologies (India) Pvt. Ltd.
68. Tata Cummins Pvt. Ltd.
69. Tata Motors Ltd.
70. T. M. Automotive Seating Systems Pvt. Ltd.
71. Toyota Kirloskar Motor Pvt. Ltd.
72. Tractors and Farm Equipment Ltd.
73. Trimble Mobility Solutions India Pvt. Ltd.
74. TVS Motor Co. Ltd.
75. Vanaz Engineers Ltd.
76. Varroc Lighting Systems (India) Pvt. Ltd.
77. VE Commercial Vehicles Ltd.
78. Virama Laminates Pvt. Ltd.
79. Volvo Group India Pvt. Ltd.
80. WABCO India Ltd.
81. Wheels India Ltd.

Committees

FINANCE & INTERNAL AUDIT COMMITTEE (FIAC) 2019-20

Chairman

Mr. Rajendra M. Petkar

Vice President- ARAI

President & Chief Technology Officer (ERC), Tata Motors Ltd.

MEMBERS:

Mr. N. D. Pathak

Executive Chairman,
Spaco Technologies (India) Pvt. Ltd.

Mr. Gopal Bhutada

General Manager - ERC
Tata Motor Ltd.

Mr. Pankaj Gupta

Vice President - External Affairs & CSR,
Skoda Auto Volkswagen India Pvt. Ltd.

Mr. Pawan Agarwal

CFO
Kirloskar Oil Engines Ltd.

Mr. Gajanan Chinchwadkar

Sr. General Manager F & A
Mahindra & Mahindra Ltd.

Mr. A. M. Manichan

Dy. Secretary,
Government of India,
Ministry of Heavy Industries & Public
Enterprises,
Department of Heavy Industry

Mr. Chetan Kamdar

Finance Director
Cummins India Ltd.

Mr. Balaram Pradhan

General Manager Finance,
Mercedes-Benz India Private Ltd.

ARAI Members On FIAC:

Mrs. Rashmi Urdhwaresh

Director-ARAI

Mr. Atul Bhide

Deputy Director
(HoD- Finance & Accounts), Member Secretary

PROJECT EVALUATION & MONITORING COMMITTEE (PEMC) 2019-20

CHAIRMAN

Mr. Aniruddha Kulkarni

Vice President & Head, CVBU Engineering Research Centre, Tata Motors Limited

MEMBERS :

Mr. Rajinder S. Sachdeva

Chief Operating Officer,
V. E. Commercial Vehicles Limited

Dr. S. J. Dhinagar

Vice President (Advanced Engg)
TVS Motor Co. Ltd.,

Mr. Pankaj Sonalkar

CEO
Mahindra Vehicle Manufacturers Ltd.

Mr. Alok Jaitley

Sr. Vice President (Engg)
Maruti Suzuki India Ltd.

Mr. S. Janardhanan

Vice President (Co-ordination),
Simpson & Co. Ltd.,

Mr. S. Sriraman

Sr. Vice President ((R&D)
Tractors and Farm Equipment
Limited)

Ms. Anuradda Ganesh

Director - Research, Innovation and
Compliance, India ABO
Cummins Technologies India Pvt. Ltd.

Mr. Ashok Yewale

Dy. Chief Technology Officer (R&D),
Force Motors Ltd.,

Mr. R. K. Jaiswal

Development Officer, (Engineering)
Government of India, Ministry of
Heavy Industries & Public Enterprises,
Department of Heavy Industry,

ARAI Members on PEMC:

Mrs. Rashmi Urdhwaresh

Director-ARAI

Mr. N. B. Dhande

Sr. Dy. Director, ARAI

Mr. Suyog Gadgil,

Manager, Member Secretary

There is also a sub-committee of PEMC to review and monitor projects of ARAI - Forging Industry Division.



Mr. C.V. Raman
President ARAI



Mr. Rajendra Petkar
Vice President ARAI

Dear Members,

I am pleased to share with you an update on ARAI's performance for the Financial Year 2019-20. Looking back, it was yet another exciting and challenging year, characterized by high activity in our existing portfolio and substantial progress on our strategic goals. Year 2019-20 has been a truly remarkable year, where the team at ARAI supported the industry in "leapfrogging" a large portfolio of vehicles from BS-4 to BS-6 in record time. I congratulate Director and all the employees for this commendable performance.



While the initial period (post COVID-19) was extremely challenging, the team at ARAI lived up to the new normal and was able to deliver an excellent performance and make considerable progress not only in our regular functions, but in taking several new initiatives required for the nation at this juncture.



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As we prepare this annual report, we are in the midst of the biggest crisis we have seen in our lifetime, the COVID-19 pandemic. So far, it has created unprecedented socio-economic disruption and tragic loss of human life. It has affected not just human health but severely impacted businesses and society at large. While the initial period (COVID-19) was extremely challenging, the team at ARAI lived up to the new normal and was able to deliver an excellent performance and make considerable progress not only in our regular functions, but in taking several new

initiatives required for the nation at this juncture.

Operational Performance

This was a satisfying year for us as we registered a growth of over 14% in our Operational Income year on year, even considering the challenging and turbulent period, particularly the last month, due to pandemic outbreak. Our growth fundamentals are in a good shape with gains in both certification as well as non-certification / developmental business. Over the years, we have built deep testing and research expertise across various automotive domains and technologies to enable growth and innovation for our customers. Our strategic decisions have enabled us to meet the needs of changing markets and will position us to emerge stronger in the future.

Our strategy provides the continuity and resilience we need for playing an essential role in the move to a cleaner and greener mobility. Our investments, the support of Department of Heavy Industry (DHI) and in-house competency development have been some of the various measures taken during the year in this direction. The Centre for Green Mobility at HTC Chakan site which was inaugurated this year, is a step in this direction. It is equipped with infrastructure for development of technologies in EV/HEV and advanced Power train.



We firmly believe that the best way to expand the envelope of our services is by building on our strengths.

We firmly believe that the best way to expand the envelope of our services is by building on our strengths. It is encouraging to note that we have extended our core strength of testing and certification of vehicles to Telecommunication sector. These efforts have been rewarded in the form of accreditation of ARAI by 'Telecommunication Engineering Centre', Department of Telecommunications as "Conformity Assessment Body" for testing of telecommunications related products. Also, we have been conferred with **Green Technology Award 2020** by ETNow for contribution towards adoption of EV Technology. The year was also marked with Director - ARAI




Over the years, we have built deep testing and research expertise across various automotive domains and technologies to enable growth and innovation for our customers.


being conferred with awards, viz. **Nari Shakti Puraskar - 2019 at the hands of Hon'ble President, Shri Ram Nath Kovind; and Business Leader of the Year Award 2020** by ET Now. On behalf of the Governing Council and ARAI Members, I take this opportunity to congratulate Director - ARAI for these achievements.

Development of new solutions has been the hallmark of our strategy and we have been expanding our presence in this area over the years. Electric Bus (E-Lite) developed was one of the new technology offerings for the industry we brought in this year, wherein a conventional bus with Internal Combustion Engine (Diesel Powertrain) has been converted to Electric propulsion. Similarly, other developments in EV/HEV area included a software for Automated Manual Transmission (AMT) controller developed with due consideration to Indian driving cycle and road conditions for application in a Small Commercial Vehicle (SCV); and a quick automatic docking solution for fast battery exchange for e-2W and e-3W. In the alternate fuels area, we are working on various customer projects for development of BS-VI CNG Engines and some of which have already been completed successfully. Also, a project has been successfully completed on development of an optimized design for Aluminium Bulker meeting the strength and fatigue requirements, wherein weight reduction of 15% has been achieved. With regards to certification and testing services, we have executed numerous assignments on BS-VI Certification, Truck/ Trailer/ Ambulance Code, Type Approval of Generator Sets, Assessment of EV/HEV as per FAME-II requirements, approvals as per FAME-I requirements, dynamic testing of Battery Modules, REESS Dynamic Test on Electric Vehicle Battery Packs etc.

With every passing year, our commitment to our customers and our resolve of unyielding integrity has only strengthened, which underlines our commitment to confidentiality and integrity to our customer data. Further, ISO/IEC 27001:2013 certification has bolstered our credentials of living up to our customers' trust in us. The other intangible factor that drives enduring success is the culture of our institute. I am humbled and energized in seeing our values and culture at every level, not just in case of our services, but also in our strong sense of purpose to our communities as we remain committed to reducing our environmental footprint. During the year, we took significant steps in this direction by way of eco-friendly disposal of waste and installation of energy efficient devices.



With every passing year, our commitment to our customers and our resolve of unyielding integrity has only strengthened, which underlines our commitment to confidentiality and integrity to our customer data.



Our singular zeal to anticipate the changing customer needs and preferences, to continuously adapt our service propositions and to deliver value to our customers has stood us in good stead all through our journey.

Our endeavour is to hone talents so that the nation becomes a skills hub in the automotive domain. We are committed to this mission and are contributing towards upskilling the industry personnel through our periodic Proficiency Improvement Programs in different automotive engineering domains. At the same time, we also remain focused on skill enhancement of our personnel through regular training programs in technical as well as behavioural areas conducted through external as well as internal experts.

Overall, I am very pleased with the strong performance delivered by us. As we look at our performance, we have grown faster & have expanded our portfolio by opening new avenues. This performance is driven by a strong and persistent focus on keeping the customer needs at the centre of everything that we do. Our singular zeal to anticipate the changing customer


needs and preferences, to continuously adapt our service propositions and to deliver value to our customers has stood us in good stead all through our journey.

The Way Ahead

As we step into the 'new normal', we would continue to take steps to understand the evolving needs of the customer. Also, we are doing all we can to ensure business continuity in these testing times and our teams are working tirelessly to help mitigate the risks. We plan to extensively use digital platforms to communicate internally and externally and execute our customer assignments considering the lockdown and post-lockdown scenario. At the same time, we do anticipate an adverse impact on our business and delivery due to the pandemic, which is inevitable due to the uncertainties and socio-economic disruption. I am confident that we will emerge from this crisis stronger. Moving into the future, we will be a more valuable partner to our customers than ever before.

I take this opportunity to reiterate that ARAI stands united with the nation during this challenging phase of COVID-19. We have proactively planned to contribute to the national cause in these challenging times by leveraging our experience and expertise in research and testing. To support the nation in tackling the crisis, we have initiated development of Face Shield for safety warriors fighting the coronavirus. Also, we took initiative to put into use our facilities for testing of ventilators. I would like to thank all the employees for their commitment and service to the society in these challenging times.

I would like to conclude by expressing my gratitude to the Vice President & Members of the Governing Council; Director - ARAI; Department of Heavy Industry (DHI); the Chairman and Members of Finance and Internal Audit Committee; the Chairman and Members of Project Evaluation and Monitoring Committee; ARAI Members and the entire ARAI team for their valuable support. Also, I would like to thank our customers and associates for the overwhelming trust, support and confidence reposed in us.



I take this opportunity to reiterate that ARAI stands united with the nation during this challenging phase of COVID-19. We have proactively planned to contribute to the national cause in these challenging times by leveraging our experience and expertise in research and testing.

C. V. Raman

Director's Report



Mrs. Rashmi Urdhwareshe
Director - ARAI
Till 3rd June 2020

The Governing Council of ARAI has great pleasure in presenting the Annual Report along with Overview of Operations and Audited Statement of Accounts for the year ending 31st March 2020. The past year was a successful year as we registered a growth of over 14%, except for the fact that we had to abruptly culminate our activities in the month of March 2020 due to the novel coronavirus pandemic. Had this temporary suspension not occurred, our growth rate would have been even more better. This pandemic is clearly concerning and we are monitoring developments very closely. The safety and well being of our people has been our overriding priority. Against this backdrop, we have delivered competitive, productive and responsible growth.

The past year was a successful year as we registered a growth of over 14% except for the fact that we had to abruptly culminate our activities in the month of March 2020 due to the novel coronavirus pandemic.

Notwithstanding the unexpected events towards the close of the year, we achieved many milestones this year. The certification as well as developmental activities have been looked at strongly by our customers and we have offered services to automotive as well as non-automotive sectors. Some of the significant milestones achieved during the year include development of Electric

The certification as well as developmental activities have been looked at strongly by our customers and we have offered services to automotive as well as non-automotive sectors.

Bus (E-Lite), Software for Automated Manual Transmission (AMT) Controller, various certification assignments relating to BS-VI & EV/HEVs and accreditation by 'Telecommunication Engineering Centre', Department of Telecommunications as "Conformity Assessment Body" for testing of telecommunication related products etc.

At ARAI, we believe in the fundamental promise of delivering robust and reliable services with integrity, for creating a tomorrow that is better than today; a tomorrow that is more sustainable and also, adds value to the society.

We see huge changes as we look at the 'new normal' and we are working to see how do we look at anticipating the needs of the ever evolving customer, so that we are able to sustain our core values and ensure that we take our institute to a different trajectory. At ARAI, we believe in the fundamental promise of delivering robust and reliable services with integrity, for creating a tomorrow that is better than today; a tomorrow that is more sustainable and also, adds value to the society. And I believe that we are moving in this direction.

On behalf of Team ARAI, I would like to thank the President, Vice President, Members of the Governing Council, Members of Finance & Internal Audit Committee, Members of Project Evaluation & Monitoring Committee, ARAI Members and Senior Officials from DHI for their continued support. I am also thankful to our customers, partners, associates and other stakeholders who have reposed their trust and confidence in team ARAI. And, most importantly, I would like to thank all the employees of ARAI for their tireless dedication. We are committed to work through the current environment and I am sure, together, we shall overcome and triumph.

Mrs. Rashmi Urdhwareshe
Director

Officiating Director's Message



Mr. Neelkanth V. Marathe
Officiating Director
w.e.f. 4th June 2020

It is an honour and privilege for me to write this message as an Officiating Director of ARAI. I am truly humbled at being appointed as the Officiating Director on superannuation of immediate past Director, Mrs. Rashmi Urdhwareshe, who steered ARAI to a new height of success and glory. I have been entrusted to lead ARAI till such a time a full-time Director joins and takes charge.

Coming to our performance, I am highly proud of achievements of ARAI in year 2019-20. Also, it is a matter of pride that ARAI's commitment to excellence in both service quality and financial performance has again been recognized by the customers. I am grateful to our customers, partners and other stakeholders for the trust and confidence reposed in us. The speed, the adaptability, the customer focus; which the entire team at ARAI has consistently demonstrated over these many years and more specifically over the last few months; gives me the highest confidence in our institute's ability to not only successfully navigate through the immediate uncertainties posed by the COVID pandemic but also keep on delivering services of highest quality and satisfaction.

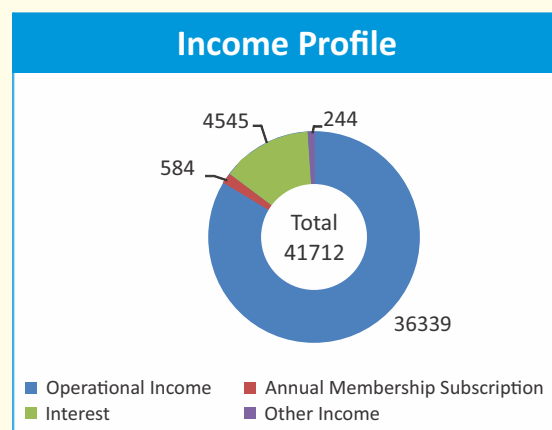
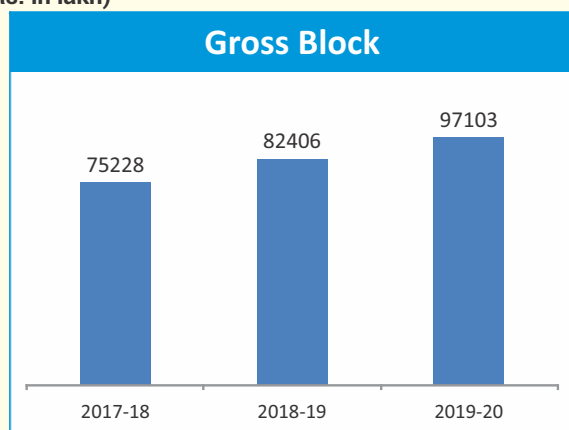
I am sure, ARAI will continue to transform to scale new heights, while remaining firmly committed to its values. I am also confident that the future of ARAI will far outshine anything that we have done before.

I would like to thank the entire ARAI Team for their relentless support and commitment during this difficult time.

Mr. Neelkanth V. Marathe
Officiating Director

Key Indicators: 2019-2020

(Rs. in lakh)



Operational Highlights

Finance & Accounts

Income & Expenditure Account, Balance Sheet and Auditor's Report are presented herewith.

Financial Performance

ARAI has continued to show excellent performance during the Financial Year 2019-20. The Income Target has been achieved and Operational Income has gone up by 14.11% to Rs. 36,338.72 lakhs in 2019-20 as compared to Rs. 31,846.19 lakhs in 2018-2019. Total Income has reached a figure of Rs. 41,712.82 lakhs as compared to Rs. 38,087.82 lakhs of last year. This is the result of several measures undertaken in overall ARAI governance, in areas such as finance, purchase, invoicing procedure, time management, productivity, competence building and Human Resource Development etc.

Investment of funds

The cash & bank assets available with ARAI have been invested in Scheduled Banks / Financial Institutions in various Deposit Schemes as per Governing Council's guidelines.

DHI Supported Projects

Projects approved by DHI's Sanctioning Committee out of Automobile Cess funds are Non-Plan/Non-Recurring Grant-in-Aid, projects approved by DHI's Main Committee out of Development Council for Automobile & Allied

Industries (DCAAI) funds are Non-Recurring Grant-in-Aid and projects approved by DHI's Project Implementation and Sanctioning Committee (PISC) under FAME-India Scheme are Non-Recurring Grant-in-Aid. ARAI also takes up R&D projects funded from its internal funds.

Appointment of Statutory Auditors

M/s. Gunwani and Kolapkar, Chartered Accountants, Pune were appointed as Statutory Auditors (In place of earlier M/s. P. G. Bhagwat) for the Financial Year 2019-20, in the Annual General meeting held on 5th Sept. 2019.

Membership Subscription

The total number of members of ARAI as on 31/3/2020 is 74 and the Annual Membership Subscription for the year under report is Rs. 584.05 lakh.

Recognition by DSIR

ARAI is recognized as a Scientific and Industrial Research Organization (SIRO) by the Department of Scientific & Industrial Research, Ministry of Science & Technology, Govt. of India for the period April 2017 to March 2020 and the same has been renewed further for the period from April 2020 to March 2023.

Income Tax

The Central Board of Direct Taxes has approved ARAI for exemption purposes under Sec. 35 (1) (ii) of the Income Tax Act, 1961, vide Notification No. 9/ 2007 (F.No. 203/18/2005-ITA -II) dated 28-3-2007 effective 01-04-2004.

Research and Development

During the year, following projects were taken up for implementation under the support of DHI.

- Establishment of calibration strategy for BS VI Real Driving Emission (RDE) by virtual technique
- Development of an E axle Powertrain Kit for 3-wheeler application in India

Some of the other research projects under internal funding include the following.

- Development of Lightweight Electric Bus 'E-Lite'
- Development of Mobile Energy Storage Device for 2 & 3W EVs
- Battery Management Systems for L Category Vehicles

Model Inspection & Certification (I&C) Test Centres

ARAI has been identified by Ministry of Road Transport & Highways (MoRTH) for facilitating establishment of model test centres for Inspection and Certification (I&C) of in-use vehicles. Under this program, ARAI has already facilitated establishment of I&C Centres at Nashik in Maharashtra; Nelamangala (Bengaluru) in Karnataka; and Surat in Gujarat. In addition to these centres, ARAI is currently facilitating establishment of similar centres in another five states and three more centres for a State Transport Department. Also, under MoRTH project, ARAI has been recently awarded with three more centres, i.e. two centres at Haldwani & Haridwar in Uttarakhand and one centre at Vishakhapatnam in Andhra Pradesh. Apart from this, contract for establishment of I&C Centre at Kurla (Mumbai) in Maharashtra has been awarded. Further, proposals meant for 28 RTOs have been submitted to state transport department for establishment centres at different locations in Maharashtra. In addition to this, as per the instructions and approved procedure of Rajasthan State Government, ARAI has carried out audits of number of vehicle fitness test centres belonging to private parties for their authorization.

ARAI – Homologation and Technology Centre (ARAI – HTC), Chakan

ARAI – Homologation and Technology Centre (ARAI – HTC) at Chakan is home to Centres of Excellence in Powertrain and Fatigue & Materials; in addition to Homologation facilities for Passive Safety (including full vehicle crash systems). This centre

caters to the present and upcoming Homologation and R&D requirements of automotive and off-highway vehicles. During the year, Centre of Excellence for Green Mobility has been established at ARAI – HTC. This centre caters to industry's requirement of technology development in the areas of alternate energy and electrification of transportation. Also, it has been augmented with addition of Whole Vehicle EMC Anechoic Chamber and Engine Transient Dynamometers.

Business Development Initiatives

- Brand building: Showcasing of capabilities and capacities at various exhibitions / symposiums like Auto Expo, Defence Expo, Light Weight Technology Summit 2019, Truck Trailer and Tyre Expo 2019, NuGen Mobility Summit 2019, Automotive e/E Technologies-Interactive Session for MSMEs, ITEC India 2019, Automotive Testing Expo India 2020 etc.
- 'Smart India Hackathon 2019–Hardware Edition' at Pune centre, was co-organized by hardware edition along with NCL, IISER & ARAI
- MoU with BHEL: Design, technology development and testing projects in EV
- MoU with ANSYS: For setting up 'Centre of Excellence in Automotive Emerging Areas'
- MoU with Michelin India: To encourage knowledge-sharing, enhance general awareness of the transportation industry and to drive forward collaborations in automobile technology projects in India
- MoU with College of Engineering Pune (CoEP), Savitribai Phule Pune University, Pune and Cummins College of Engineering for Women: For conducting 1-year Post Graduate Diploma in Electric Mobility
- MoU with Blue Planet, South Korea: For cooperation in automotive areas like engine design and development; testing and calibration
- MoU with Madhya Pradesh Pollution Control Board (MPPCB): For a project on 'Emission Inventory and Source Apportionment Study for Bhopal City'
- Collaboration Agreement with Sweden India Transport Innovation and Safety Partnership (SITIS): In the area of Traffic Safety and Transport Innovation in India and Sweden. The other parties to this agreement include

Automobile Companies, Academic Institutions and Swedish Transport Administration

- New services and capabilities: Testing and validation of telecommunication related products, battery packaging optimization, dynamic testing of battery module, battery packaging (cells to pack), validation testing of seats as per ADR-34, durability testing of High Speed Automatic Transmission, efficiency mapping of Heavy Duty Axles, Metro seats validation for performance and durability, Drop test of Advanced Light Helicopter (ALH) fuel tank, simulation for sizing of xEV drivetrain components, Diesel Engines-NOX reduction agent AUS 32, RoHS testing, material characterization for vehicle (BIW) etc.

Systems Compliance and Quality Management

- ARAI has been accredited by 'Telecommunication Engineering Centre', Department of Telecommunications as "Conformity Assessment Body" for testing of Telecommunications Related Products
- Successful completion of OHSAS 18001:2007 upgradation to new standard ISO 45001:2018

- Successful completion of Surveillance Audit for ISO 9001:2015, ISO 14001:2015, ISO 27001:2013
- Successful completion of Desktop Audit by NABL for Testing and Calibration fields for ISO / IEC 17025:2005 scope
- Eco friendly disposal of waste - crash vehicle disposal in eco-friendly way
- Recycling of plastic waste through SPCB approved service provider
- 'Swachhta Pakhwada' organized during 16th to 31st August 2019

Corporate Social Responsibility (CSR)

ARAI is at the forefront of Corporate Social Responsibility (CSR) and sustainability initiatives. Our core CSR strategy is to engage meaningfully with disadvantaged communities. Our work spans across domains, viz. community development, education and health. Accordingly, this year, we provided financial assistance to about twenty programs undertaken by various NGOs in these domain areas. In addition to this, we have contributed to PM Care Relief Fund for providing assistance to COVID-19 affected people.

- ▶ **Development and Testing Activities**
- ▶ **New Facilities**
- ▶ **Human Resource Development**
- ▶ **Corporate Social Responsibility (CSR)**
- ▶ **Technology / Research Publications**
- ▶ **Business Development**
- ▶ **Events**
- ▶ **Knowledge Centre**
- ▶ **ARAI Homologation and Technology Centre (ARAI - HTC), Chakan**

Development and Testing Activities

ARAI undertakes research and development programs to build competencies, capabilities and competitiveness, which in turn has reflected in its consistent growth. Leveraging its inherent strengths in different automotive engineering domains, ARAI has successfully executed various government supported / industry funded / internally funded research projects. Some of the research projects implemented during 2019-20 are listed below.

Design & Development

■ E-Lite - Electric Bus Development

ARAI has successfully developed E-Lite - Electric Bus, wherein a conventional bus with Internal Combustion Engine (Diesel Powertrain) has been converted to Electric propulsion. A 12 m Semi Low Floor Aluminium Superstructured bus prototype developed under a DHI supported project has been used in this project. E-Lite was showcased at Auto Expo 2020 and has generated a very keen interest in the industry.



◀ E-Lite – Electric Bus Development ▶

This developed bus, i.e. E-Lite meets FAME-II requirements and complies to AIS:123 regulatory requirements. It is with 160 kW PMSM motor and 150 kWh LPF batteries, and accordingly, provides a range of 150 km for every charge. This outcome will be helpful for transport corporations as they can

convert their existing ICE powertrain bus fleets to electric vehicles, since they generally scrap them after few years of service. This will further lead to an additional life span of 8 to 10 years for such buses. It is sure to provide an impetus to the transport corporations in particular in moving towards electric vehicles, specifically in case of public transport application.

■ Development of Mobile Energy Storage Device for 2 & 3 WEVs

A quick automatic docking solution for fast battery exchange for e-2W and e-3W has been developed by ARAI. A dedicated park and charge solution takes about 4 to 5 hours, whereas this battery swapping solution takes about 30 seconds. Vehicle manufacturers stand to gain from this system



◀ Development of Mobile Energy Storage Device for 2&3 WEVs ▶

as it provides an opportunity to sell vehicle separately from battery and provide battery on lease / pay-per-use model, in turn reducing vehicle cost by 30 to 40%. In case of the end users, it helps them in easy removal of battery from vehicle for charging at home.

This mobile energy storage solution is equipped with a high voltage interlock protection circuit, thereby, helping in maintaining the battery in safe operating condition under any potential fault(s). The IP67 rated design ensures electrical isolation between cells and mechanical enclosures to avoid

short-circuit issues inside the battery pack. Another key feature is that it eliminates use of cable due to the direct docking and connects the battery with vehicle and auxiliary systems

■ **AMT Controller Development**

Leveraging its experience in Electric / Hybrid vehicle control systems, ARAI has developed a software for Automated Manual Transmission (AMT) controller with due consideration to Indian driving cycle and road conditions for application in a Small Commercial Vehicle (SCV). The salient features of this controller include creep functionality, take off & launch, garage shift, coast functionality, engine stall protection, diagnostics & limp home and HIL level verification and validation. Further, this controller has been integrated with IVCON supervisory control, specifically for hybrid configurations. With this experience, ARAI has developed the competencies to provide following services with respect to transmission systems.

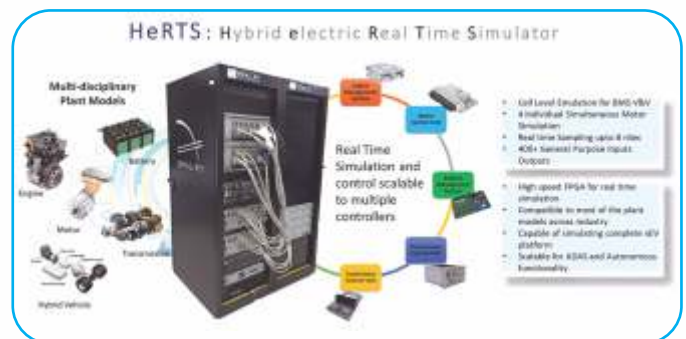
- ▶ HIL setup for verification & validation of AMT controller
- ▶ Methodology for building plant model
- ▶ Integration support for hybrid and AMT controller
- ▶ E-clutch deployment on vehicle
- ▶ Artificial Intelligence techniques for AMT functionality



■ **Hybrid Electric Real-time Simulator**

Hardware-in-the-loop (HIL) simulation, an industry-standard testing process, is extensively used globally for verification and validation of Electronic Control Units (ECUs), Motor Control Units (MCUs) and Battery Management Systems. It is being used in multiple phases of electrified vehicle development as a virtual real-time platform for testing and validation of control strategy analysis.

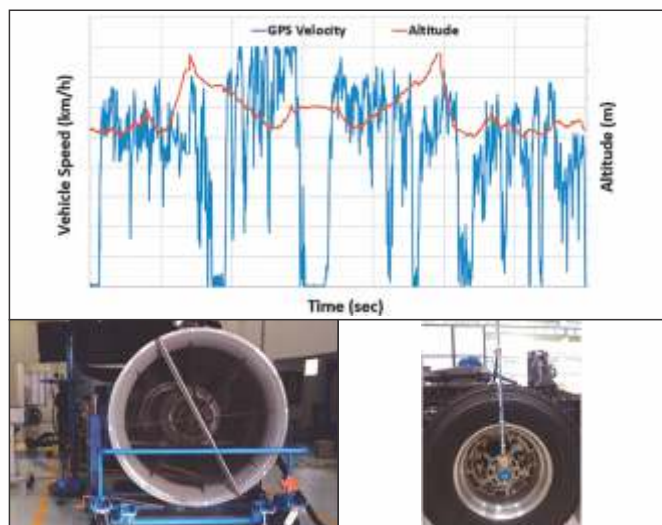
Considering the above, ARAI is currently working on in-house development of HiL based Hybrid Electric Real Time Simulator (HeRTS) for testing, verification and validation of hybrid and electric systems like Motor Controller, Battery Management System and Vehicle Control Unit. This simulator will have features for real-time simulation & testing of motor, battery management system, engine and other general purposes. It will be useful for real-time simulation, verification and validation of complete electric and hybrid automotive system



■ **Heavy Duty Vehicle Fuel Consumption Calculation Using VECTO Test Procedure**

Under this project, VECTO defined test procedure was evaluated on 6x2 tractor trailer configuration. Test track activities were carried out to measure vehicle's drag coefficient as per constant speed test procedure in VECTO and road load constants using coast down test. Vehicle's capability was verified to negotiate mWHVC and VECTO mission profiles on Chassis Dynamometer. Further to the evaluation, vehicle was tested on-road to measure

fuel consumption (FC) and real world drive cycle data (vehicle speed and gradient) for default payload condition. Subsequently, engine testing

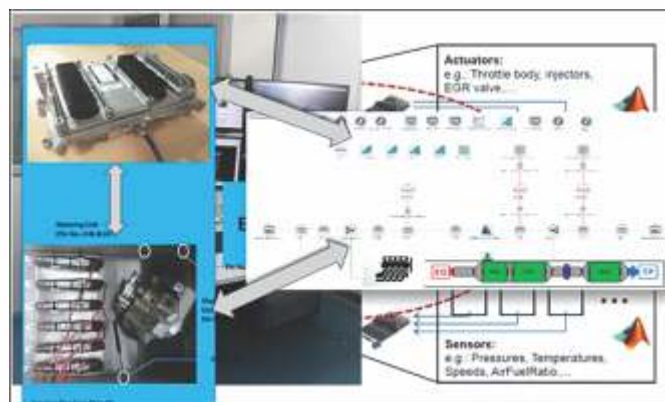


◀ **Real World Usage Pattern Data Collection Exercise** ▶

for FLC, PTP, cold & hot WHTC, gearbox & differential torque loss measurements, RRC tests for tires were carried out as per defined procedure. A simulation model was built successfully in VECTO using above mentioned measured test data to calculate FC. The calculated FC for mWHVC and on-road real world drive cycle was observed to be in close agreement with the measurements. Moreover, sensitivity analysis of default auxiliary (fan, electric & pneumatic systems, steering pump, HVAC) power consumption values was carried out which indicated an impact of about 3% on FC.

■ **Calibration Strategy for BS-VI Real Driving Emission (RDE) by Virtual Technique**

This ongoing project, supported by DHI, is for establishing of a calibration strategy for BS-VI Real Driving Emission (RDE) by virtual technique. In this project, baseline testing for plant model validation has been carried out, wherein steady state and transient data were measured; and a refined engine and after-treatment model have been developed. Further, RDE setup was prepared for open loop & closed loop commissioning; and engine was validated on Virtual Test Bed (VTB). Also,



◀ **Open Loop & Closed Loop Commissioning** ▶

calibration for different RDE cycles using VTB (with due consideration to all possible variations), including vehicle PEMS test & validation, have been completed.

■ **BS-VI CNG Engine Development**

During the year, ARAI has worked on development of BS-VI CNG Engine from existing BS-IV CNG Engine for its customers. Some of these projects are given below.

▶ BS-VI compliant six cylinder, naturally aspirated, single point injection CNG engine has been developed from an existing BS-IV CNG engine. It involved baseline performance of existing BS-IV CNG engine to study the gap in existing emission levels and BS-VI emission levels to be achieved. The methodology included review of design parameters & simulation study to achieve targeted emission results; after-treatment review & selection; steady state calibration to achieve desired power performance; transient calibration to achieve BS-VI emission norms and BS-VI OBD-I calibration for emission & non-emission related faults. The outcome was successful demonstration of BS-VI compliant single point injected, naturally aspirated CNG engine.

▶ The objective of this ongoing project is to demonstrate BS-VI emission compliant CNG engine by using existing BS-IV CNG engine and to compare the difference in emissions by using CNG gas of varying methane content. It involves carrying out



◀ **BS-VI compliant H6NA CNG Engine** ▶

baseline performance of existing BS-IV CNG engine for studying the gap in existing emission levels and BS-VI emission levels to be achieved. It also includes review of design parameters, simulation, steady state calibration to achieve desired power performance, after-treatment review & selection, transient calibration to achieve BS-VI emission norms, BS-VI OBD-I calibration, demonstration of BS-VI emission compliant CNG engine and studying the difference in emissions by using CNG gas of varying methane content.

▶ Similar to the above project, ARAI is also working on development of two engines, viz. 4 cylinder & 6 cylinder BSVI compliant turbocharged &



◀ **6 cylinder TCIC CNG Engine Setup** ▶

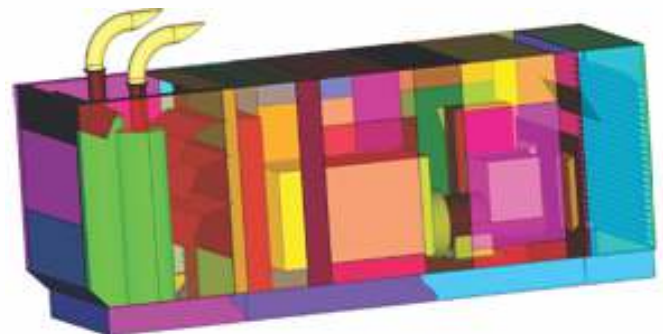
intercooled, multi-point injection CNG engine from existing BS-IV CNG engine. The project

methodology is similar to the above project and so includes, baseline performance of existing BS-IV CNG engine for studying gap in existing emission levels and BS-VI emission levels to be achieved; review of design parameters & simulation study to achieve targeted emission results; after-treatment review & selection; steady state calibration to achieve desired power performance; transient calibration to achieve BS-VI emission norms; and BS-VI OBD-I calibration for emission & non-emission related faults.



◀ **H6TC CNG engine in Transient Calibration Phase** ▶

■ **Enclosure Design for High Capacity Diesel Generator Set Family**

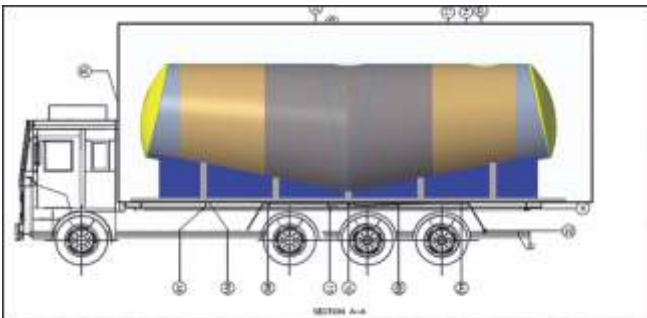


Statistical Energy Analysis (SEA) methodology has been deployed in designing an Enclosure solution for high capacity Diesel Generator Sets meeting CPCB noise norms and intact cooling performance. The major highlights of this design were its compact footprint, muffler inside the canopy and quick solution time.

Design Optimization & Simulation

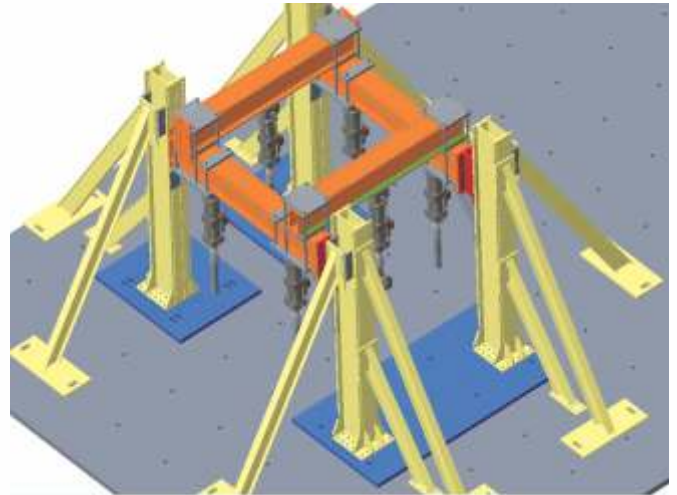
■ Weight optimization of Aluminium Bulker Design

ARAI has successfully completed a project on development of an optimized design for Aluminium Bulker, wherein the weight has been reduced by 15%. This optimized design of Bulker meets the strength and fatigue requirements under Indian road load conditions. The reduction in weight of the bulker due to the optimized design has resulted in fuel economy improvement during empty trip and improved payload capacity without compromising strength aspects. The customer has benefited by way for new fleet orders of bulkers and these bulkers are presently running on Indian roads successfully.



■ Durability Strength Assessment by FEA Technique

FEA technique has been successfully deployed to carry out strength assessment of Load Frame Test Rig for specified loading conditions. This strength



assessment was carried out under severe loading conditions, viz. cyclic loading, variable loading & vibration analysis. Based on this assessment, structural modifications to meet the material strength criteria were suggested to the customer in the rig design.

Certification and Testing

Certification and testing is ARAI's strength and this has been acknowledged by various authorities through their accreditations and recognitions as given below.

- ▶ Recognition by National Traffic Safety and Environment Laboratory (NTSEL), Japan to carry out the Tests as per TRIAS 31
- ▶ Recognition by RDW, Netherlands as 'Technical Service Provider' to carry out CoP verification audits
- ▶ Accreditation by Land Transport Authority (LTA) and National Environmental Agency (NEA), Singapore as 'Recognized Overseas Test Lab'
- ▶ Recognition by Department of Infrastructure, Australia to provide Test Reports in compliance to ADRs (Australian Design Rules)
- ▶ Accreditation by Telecommunication Engineering Centre, DoT as "Conformity

Assessment Body” for Testing of Telecom Equipment

ARAI has executed numerous assignments on certification, testing, validation, evaluation, data acquisition, data analysis etc. in 2019-20. Details of some of the projects are given below.

Certification & Validation Projects

■ Type Approval & Certification

- ▶ BS-VI Certification
- ▶ Assessment of EV/HEV as per FAME-II
- ▶ Approval under Fame-I Scheme – L1, L2, L5, M1 and M3 categories
- ▶ Truck Code, Trailer Code, Ambulance Code
- ▶ Bus Body Plant Accreditations

■ Noise Compliance for Generator Sets

- ▶ Diesel Genset models as per CPCB guidelines
- ▶ Extension of Type Approval Certificates to Generator Original Equipment Manufacturers (GOEMs) as per Central Pollution Control Board (CPCB) guidelines
- ▶ Conformity of Production (COP) tests for OEM & GOEM plants
- ▶ Conformity of Production (COP) tests for Petrol Genset models
- ▶ Type Approval of Gas Generator models

■ Validation & Testing Assignments

- ▶ Benchmarking and Tear Down Analysis of Electric Vehicle
- ▶ Dynamic Testing of Battery Modules
- ▶ Dynamic Testing of Interior Fittings
- ▶ Airbag ACU Calibration

- ▶ Seat Structure Validation Tests with 95th Percentile Dummies
- ▶ Safety Belt Testing
- ▶ REESS Dynamic Test on Electric Vehicle Battery Packs
- ▶ ADR 59 Full Bus Rollover
- ▶ ADR 34 Testing for Seating System
- ▶ Side Pole Impact Testing
- ▶ Accreditation of Proving Ground for Brake with ABS and Gradient Test Tracks
- ▶ Test Track Re-accreditation
- ▶ Developmental Testing of Crash Sensing Emergency Call device (e-call)
- ▶ Developmental Testing of Aluminum Foam filled Automotive Bumper Beams
- ▶ Developmental Crash Testing of new Vehicle Models
- ▶ Static and Durability Testing of Electric 2-wheeler Frame
- ▶ Interior Fittings Testing
- ▶ Drop Test of Advanced Light Helicopter (ALH) Fuel Tanks
- ▶ Taxi Roof Lamp Testing
- ▶ Cabin NVH of Excavator
- ▶ Exhaust System Noise and Backpressure Evaluation
- ▶ Fatigue Characterization of Sheet Metal Materials
- ▶ Metallurgical Failure Analysis of Components
- ▶ Residual Stress Analysis on Cylinder Block and Head

- ▶ Design validation of Material Handling Equipment
- ▶ Candidate Lube Oil Evaluation

Evaluation and Assessment Projects

■ Clean Air Project in India (CAP India)

As reported in the financial year 2018-19, The Swiss Agency for Development and Cooperation (SDC) is supporting India's National Clean Air Programme through 'Clean Air Project in India' (CAP India) for implementation in four cities, viz. Kanpur, Lucknow, Pune and Nashik. This project will be implemented by a consortium of institutes including: The Energy and Resources Institute (TERI), The Automotive Research Association of India (ARAI), École polytechnique fédérale de Lausanne (EPFL), International Institute for Applied Systems Analysis (IIASA) in partnership with city authorities. These four cities were selected after conducting a scoping study, which considered several factors such as severity and sources of air pollution, population density and associated health impacts, economic standing of the state, readiness or preparedness of state in terms of policies / regulation etc. It emphasizes on improved data measurement and analysis on clean air; clean air policies and action plans development & implementation; and raising awareness for clean air. The Phase-I of CAP India was announced at the World Sustainable Development Summit 2020 in New Delhi. ARAI has been entrusted with implementation of this project in Pune city. Major activities carried out in the year include preparation of action plan; discussions with MPCB officials on project components & collection of data on industries in Pune district; and consultation with Pune Municipal Corporation (PMC) on the state of air quality & ongoing efforts for controlling and abatement of air pollution.

■ Perimeter Fence Evaluation

Evaluation of Perimeter Fence for Hostile Vehicle Mitigation application has been undertaken. The evaluation was done as per ASTM F2565-18 standard, which provides an impact vehicle penetration rating, along with feasibility of such a vehicle barrier to effectively stop the hostile vehicle. In this project, a 7200 kg Heavy Goods Vehicle was rammed into this cable and post fence at a velocity of 80 km/h. The perimeter fence not only was effective in stopping the vehicle within less than 1 m penetration distance, but was observed to be remained standing, thus maintaining the perimeter between two end posts.



■ Durability Testing of High Speed Automatic Transmission

TGTC facility at ARAI has a dedicated test setup to perform various kinds of performance and durability testing on complete driveline and its



components such as Transmission, Rear Axle, Transaxle, Transfer Case etc. This facility has been used for development of competency in durability testing of high speed Automatic Transmission. This type of test is a first of its kind in India wherein, complete driveline consisting of fully automatic transmission, propeller shaft and differential with half shafts were tested for durability. During the tests, the maximum vehicle velocity achieved was 275 kmph. This competency development project involved development of capability in communication and control test specimen through CAN FD module. All forward and reverse gears were tested and various vehicle level signals were simulated while communicating with specimen. Functionality of valve body was monitored with the help of various pressure sensors and a detailed analysis of test data was carried out to understand the behaviour of test specimen throughout the durability test.

■ Noise - Identification, Evaluation & Reduction

Noise source identification was carried out on 9 ltr CNG Heavy Commercial Engine, wherein, sound power of the engine was evaluated as per ISO 3745 at various loads and speeds. The vibrations on critical components were measured to arrive at various resonances contributing to the overall noise. Also, sound intensity mapping on various

engine components was carried out to identify noise source ranking and percentage contribution.

Measurement and Analysis Projects

■ Generation of India Specific Dataset for Machine Learning

Advanced Driver Assistance Systems (ADAS) are enabling drivers to handle different situations effectively semi-autonomously. It automates dynamic driving tasks like steering, braking and acceleration of vehicle for controlled and safe driving with the use of radar, vision and various sensors, including LIDAR. However, integration of these technologies, requires labeled data to train the algorithm for detecting various objects and moments of driver. Image annotation is one the well-known service to create such training data for computer vision and hardly any dataset is available for India specific road conditions.

So, in order to capture the India specific objects on road, ARAI had taken up an exercise to capture data for various environmental & road conditions and annotating objects through cameras. 2-D bounding boxes were used to annotate objects in an image. These annotations have been verified and validated



with open source algorithm and have been made available in open-domain formats viz. PascalVOC and YOLO. The salient features of this dataset includes:

- ▶ 65,000 images with corresponding annotation,
- ▶ 2D bounding box creation on the images carried out for data of two Indian States
- ▶ Annotations developed are with universally accepted .xml and .txt format for Bikes, Tempos, Trucks, Auto Rickshaws, Traffic Signs and Traffic Lights
- ▶ Data can be directly used for training Machine Learning algorithms
- ▶ Separate viewer tool developed for viewing images with embedded annotations

■ **Emission Inventories Development under National Supercomputing Mission for Urban Modelling**

The objective of this ongoing project is development of high resolution emission inventories and conducting dispersion modelling analysis for four Indian cities, viz. Bengaluru, Pune, Bhubaneswar and Ahmedabad. ARAI has joined the consortium of National Supercomputing Mission (NSM) for Urban Modelling to work on this project titled 'Urban modelling development of multi-sectorial simulation lab and science based decision support framework to address urban environment issues'. The major activities in this project include the following.

- ▶ Conducting primary data collection for generating activity data in the selected cities and development of high resolution city-level emission inventories, i.e. 1 x 1 km² for outer city areas and 0.4 x 0.4 km² for core city areas for different pollutants
- ▶ Projection of baseline emission loads and development of control scenarios for future

- ▶ Conducting city-level dispersion modelling analysis for the four cities using models such as AERMOD and CALPUFF
- ▶ Chemical speciation and receptor modelling based source apportionment of PM_{2.5} for Bengaluru city

■ **Emission Inventory and Source Apportionment Study for Bhopal City**

This ongoing project is on generation of emission inventory of pollutants and to carry out particulate matter (PM₁₀ & PM_{2.5}) source apportionment for Bhopal city in Madhya Pradesh. The methodology being adopted for this purpose is given below.

- ▶ Sampling and laboratory analysis of Particulate Matter (PM₁₀ & PM_{2.5}) using specification samplers at identified locations in Bhopal city
- ▶ Carrying out PM₁₀ & PM_{2.5} source apportionment study through receptor modeling using CMB8.2 model
- ▶ Development of GIS - based gridded (2 km x 2 km resolution) emission inventory for air pollutant particulate matter less than 10 microns (PM₁₀), particulate matter less than 2.5 microns (PM_{2.5}), Sulphur dioxide (SO₂), Carbon Monoxide (CO) and oxides of Nitrogen (NOx) for base year 2020
- ▶ Projecting the baseline emission loads using growth rate method for future years and plan control actions in consultation with stakeholders
- ▶ Generating the spatial distribution of PM₁₀ & PM_{2.5} concentrations using a suitable dispersion model
- ▶ Preparing a comprehensive action plan for reducing, control, and abatement of PM₁₀ & PM_{2.5}.

New Facilities

CENTRE OF EXCELLENCE FOR GREEN MOBILITY

- EV / HEV Facilities at Centre for Green Mobility:



◀ E-Motor Test System ▶



◀ Battery Emulator ▶



◀ Battery Cell Tester with Temperature Chamber ▶



◀ Battery Pack Tester ▶



◀ Battery Abuse Testing Machine ▶



◀ Battery Module Test System ▶

■ EV / HEV Facilities at Centre for Green Mobility:



◀ Charger Interoperability Testing System ▶



◀ Battery Vibration Testing System ▶



◀ EFT and Surge Test System ▶



◀ Harmonics and Flicker Emission System ▶

■ Emission Facilities at Centre for Green Mobility



◀ Transient Engine Test Facility (220 kW and 500 kW Engine Test Cells) ▶



◀ Conditioned Air Handling Unit ▶



◀ Raw Emission Analyzer ▶



◀ Weighing Chamber ▶

■ Other Major Facilities:



◀ Miniature on-board High Speed Camera System ▶



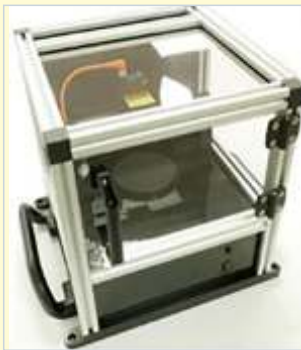
◀ Special Crash sensors and Data Acquisition System ▶



◀ 3D Coordinate Measurement Machine ▶



◀ Advanced Pedestrian Protection Test Tool ▶



◀ Impedance Tube, Porosity, Quasi-Static Mechanical Analyzer ▶



◀ Digital Image Correlation System with Ultra High Speed Camera ▶



◀ Tyre Rolling Resistance Test Facility ▶



◀ Long Stroke Actuator for ROPS Test Facility ▶

■ Other Major Facilities:



◀ Particle Number Counter System ▶



◀ Particle Number Counter System ▶



◀ Particle Number Counter System ▶



◀ Portable High Total Hydrocarbon Measurement System ▶



◀ Micro Soot Measurement System ▶

Human Resource Development

We, at ARAI, believe that our employees are our most important assets. Their comprehensive knowledge, competence, ideas, commitment and motivation are indispensable to our success. We focus on creating a workplace for tomorrow that promotes a collaborative, transparent and participative organization culture. Our strategies are focused on creating learning opportunities, build careers, and foster an empowering and inclusive culture for our employees.

Learning and Development

ARAI recognizes that attracting and training the best-in-class talent, while ensuring long term people sustainability is a key for growth. Accordingly, being a world-class institution, ARAI offers opportunities to work with latest facilities & technologies and focuses on training. It is focused on making significant investments in learning and development in line with its business imperatives, as well as the evolving expectations of the employees. It has a comprehensive learning and development program catering to skill upgradation through leadership, behavioural, technical and functional needs of the employees. During the year 2019-20, a total of 23,951 man-hours of training was imparted to the employees.

Competency Mapping

Competency mapping initiative will help in addressing the objectives of critical resources, identification of new areas for dynamic changes, manpower planning, new service procurements, acquiring readymade skill sets, succession planning and career development of the employees. As part of this exercise, a systematic approach is

being adopted for understanding the critical processes, identifying job specific competencies (technical & behavioral) along with benchmarking best industry practices and mapping them with existing skill sets of individuals. The initiative is being implemented in a phased manner. Under the first phase, the critical technical departments were mapped. During the year, the second phase was initiated for mapping of remaining technical departments. The second phase is expected to be completed by the third quarter of financial year 2020-21. Implementation of the third phase is planned for the financial year 2021-22.

Facilitating Conducive Work Environment

ARAI aims to build an inclusive and empowering work environment focused on enhancing employee experiences, engagement and talent optimization. It also builds a larger sense of connectedness and emphasizes values of sensitivity.

To strengthen these connects, ARAI organizes cultural programs during its Annual Day celebration to encourage employees as well as their family members to showcase their talents. This year's Annual Day was celebrated with zeal and enthusiasm. On this occasion, various awards like model employee of the year, special recognition award, welfare awards, merit awards for employees' children etc. were distributed. Other events held during the year included hosting of cadets from Military Institute of Technology (MILIT); Sporting Events & Yoga Sessions for the employees; and celebration of Women's Day, Independence Day, Republic Day, National Safety Week & Blood Donation Camp.



◀ Visit of Cadets from Military Institute of Technology ▶



◀ Sporting Events for Employees ▶

Corporate Social Responsibility (CSR)

ARAI is at the forefront of Corporate Social Responsibility (CSR) and sustainability initiatives. Our core CSR strategy is to engage meaningfully with disadvantaged communities. We believe in making lasting impact towards creating a just, equitable, humane and sustainable society. We have been involved with social initiatives for more than a decade and engaged in various activities in the domains, viz. community development, education and health. Accordingly, this year, we provided financial assistance to about twenty programs undertaken by various NGOs in these domain areas. The projects supported financially under CSR are given below.

- ▶ Solar System for Grammangal, Aine
- ▶ Assistance for procuring, assembling and providing bicycles to needy students of Hindavi Parivar, AP. Kurdu, Tal. Madha, Dist. Solapur
- ▶ Procurement and fitment of MS Sheets for existing shed and completion of construction of toilet for Vishwakalyan Manav Seva Sanstha, Vitthalwadi, Dehugaon, Pune
- ▶ Procurement of garden equipment and overhead water tank for Ramakrishna Math, Pune
- ▶ Drinking water tanker for residents of the Grampanchayat of Ekhatpur-Munjwadi and Khanavadi, Tal. Purandar, Pune
- ▶ Installation of Net Metering System based on Solar Energy at Sadhana Village, Chikhalgaon, Mulshi
- ▶ Spreading awareness amongst children on addiction of tobacco in association with P.A.C.E. group, Pune
- ▶ Procurement of roti maker and other accessories for Snehavan, Alandi - Vadgaon Road, Pune
- ▶ Installation of solar water heater for Shri Ganesh Shikshan Prasarak Mandal, Latur
- ▶ Procurement of bunk beds for children staying in the care center of Regional Probation and after Care Association, Baramati
- ▶ Installation of 12 kW solar system for Deendayal Nav Rachana Pratishthan, Sondara Gurukulam, Beed
- ▶ Procurement of benches and kits for 11th and 12th standard students for Padmabhushan Tarabai Modak Vidhyanagari, Kosbad, Dahanu, Palghar
- ▶ Education, social, medical, art, culture and sports activities for the under privileged at Laxmiprabhakarsut Charitable Foundation, Nigdi, Pune
- ▶ Procurement of school kits for the under privileged at Seva Sahayog, Pune
- ▶ Cupboards and lockers for children staying at Naisargik Shikshan Sanshodhan va Prashikshan Sanstha, Malavali
- ▶ Medicines for cancer patients through Cancer Patients Aid Association, Pune
- ▶ Provided financial assistance to PM Care Relief Fund for helping the COVID-19 affected patients.
- ▶ Distribution of blankets, grocery etc. to flood victims after the floods caused in the rainy season.
- ▶ Participation in fund raising sporting events organized by Concern India, Pune and Rotary Club of Nigdi-Pune



◀ Assistance for Procurement of Solar System ▶



◀ Assistance for Procurement of Benches ▶

Technology / Research Publications

- ▶ 'Design and Optimization of Crash-Box of Passenger Vehicle to Enhance Energy Absorption' by Shreyas Sarage (ARAI Academy Student) and Mohammad Rafiq B. Agrewale & Dr. K. C. Vora of ARAI in April 2019 at Asia-Pacific Automotive Engineering Conference (APAC-20), Bangkok, Thailand
- ▶ 'Development of Pedestrian Headform Finite Element(FE) Model using LS-DYNA and Its Validation as per AIS 100/ GTR 9' by N. A. Kulkarni, S. R. Deshpande, and R. S. Mahajan in May 2019 at 12th European LS- DYNA Conference 2019, Koblenz, Germany
- ▶ 'Collaborative work of simulation and inspection for plastic product development' by K. Koley in May 2019 at Plastic Day Conference, Association of Plastic Manufacturers, Pune
- ▶ 'Development and Validation of Pedestrian Headform Finite Element (FE) Models for AIS 100 / GTR 9 by S. R. Deshpande, Nachiket Kulkarni and R. S. Mahajan in June 2019 at NAFEMS World Congress, Quebec City, Canada
- ▶ 'Evaluation of Electro-Magnetic Interference of components in a Hybrid Electric Vehicle using Altair Feko' by H. Rajesh, S. S. Dandge and R. S. Mahajan in June 2019 at Altair Technology Conference, Bangalore
- ▶ 'Forging Advances towards Lightweighting' by S. A. Kulkarni in July 2019 at Forging Research Conference, Pune
- ▶ 'Manufacturing simulation and solutions for aluminum cold forming process' by S. A. Kulkarni in August 2019 at Arkey Conference, Pune
- ▶ 'Die Wear Prediction - Make it Real' by A. R. Kumbhar in October 2019 at Transvalor User Conference, France
- ▶ 'Performance Analysis of an Automated Manual Transmission Controller for Two-Wheeler' by Saurabh S. Patil (COEP Student) and K. P. Wani of ARAI published in October 2019 at ADMMS Conference, Chennai
- ▶ 'Design and Development of a Semi Active Electromagnetic Suspension System' by Palash Agrawal, Amey Desai & Jaya Surya Mallireddy (VIT Students) and K. P. Wani of ARAI published in October 2019 at ADMMS Conference, Chennai
- ▶ 'Thermal behavior analysis of Lithium ion cells used in EVs and HEVs' by Shubham Lonkar (ARAI Academy Student), Vikrant Bhalerao of MPCB and Aatmesh Jain of ARAI in October 2019 at ADMMS Conference, Chennai
- ▶ 'Avenues for Light weighting in Automotive - An Overview' by M. A. Patwardhan in November 2019 at LWT Conference, Chennai
- ▶ 'Impact of Wheel-Housing on Aerodynamic Drag and Effect on Energy Consumption on an Electric Bus Body' by Amitabh Das & Yash Jain (ARAI Academy Students) and Mohammad Rafiq B. Agrewale & Dr. K. C. Vora, of ARAI in November 2019 at NuGen Mobility Summit'19, ICAT, India
- ▶ 'Aerodynamic Analysis of Race Car Using Active Wing Concept' by Prakash P Bhanushali (ARAI Academy Student) and Mohammad Rafiq B. Agrewale & Dr. K. C. Vora of ARAI in November 2019 at NuGen Mobility Summit'19, ICAT, India
- ▶ 'Aerodynamic Analysis of Electric Passenger Car Using Wind Turbine Concept at Front End' by Snehil Mendiratta & Sugat Sharma (ARAI Academy Students) and Mohammad Rafiq B. Agrewale & Dr. K. C. Vora, of ARAI in November 2019 at NuGen Mobility Summit'19, ICAT, India

- ▶ 'Aerodynamic Analysis of a Passenger Car to Reduce Drag Using Active Grill Shutter and Active Air Dam' by Raghav Tandon (ARAI Academy Student) and Mohammad Rafiq B. Agrewale & Dr. K. C. Vora, of ARAI in November 2019 at NuGen Mobility Summit'19, ICAT, India
- ▶ 'Ride-Comfort Analysis for Commercial Truck Using MATLAB Simulink' by Sarnab Debnath (ARAI Academy Student); B. Subrat, Krishna Achanta, Pranay Jain & Sumit Bharti of (VE Commercial Vehicles, Ltd.) and Mohammad Rafiq B. Agrewale of ARAI in November 2019 at NuGen Mobility Summit'19, ICAT, India
- ▶ 'Combustion Optimization and In-cylinder NOx and PM Reduction by using EGR and Split Injection Technique' by Madhankumar (ARAI Academy Student) and Aatmesh Jain & Dr. K. C. Vora of ARAI in November 2019 at NuGen Mobility Summit'19, ICAT, India
- ▶ 'Development of Diesel Particulate NOx Reduction DPNR System for Simultaneous Reduction of PM and NOx in Diesel Engines' by E. Parthiban (ARAI Academy Student) and Aatmesh Jain & Dr. K. C. Vora of ARAI in November 2019 at NuGen Mobility Summit'19, ICAT, India
- ▶ 'Active Control using Smart Materials for 2-Wheeler Handle Bar Vibration' by Shivam Setia, V. S. Kuwar, P. R. Pawar, Ms. M. S. Jambhale and M. R. Saraf in December 2019 at International Transportation Electrification Conference India 2019, Bengaluru
- ▶ 'Design of a concept Electric Mini Tractor' by Amitabh Das & Yash Jain (ARAI Academy Students) and. Mohammad Rafiq B. Agrewale, Dr. Yogesh Bhatshvar & Dr. K. C. Vora of ARAI in December 2019 at International Transportation Electrification Conference, Bengaluru
- ▶ 'Evaluation of HCV Engine Performance using Diesel Ethanol blend' by P. S. Sutar, D. Bandyopadhyay, S. B. Sonawane, S. D. Rairikar, K. P. Kavathekar and Dr. S.S. Thipse in January 2020 at 24th Refining & Petrochemicals Technology Meet, BIEC, Bengaluru
- ▶ 'Prediction and validation of Fuel economy for Tractor-trailer configuration using GT-Drive' by K. Karthick, S. U. Gijare, Dr. S. Juttu and Dr. N. H. Walke in January 2020 at GT Conference, Pune
- ▶ 'Material Characterization and Analysis on the Effect of Vibration and Nail Penetration on Lithium Ion Battery' by Ajeet Babu, K. Parasumanna, Ms. U. S. Karle and M. R. Saraf published in World Electrical journals
- ▶ 'Impedance Analysis and Equivalent Circuit Modelling of Cells subjected to Sinusoidal Vibration Test using Electrochemical Impedance Spectroscopy' presented at International Transportation Electrification Conference India (ITEC) India 2019 and published in IEEE journal
- ▶ 'Aluminum for Curbing GHG Emission in Indian Public Transport Buses' published at WCX SAE World Congress, USA
- ▶ 'Optimisation of Direct Methanol Fuel Cell' by Satvik Huria & Akshay Pundir (ARAI Academy Students), Thundil Karrupa Raj of VIT and Aatmesh Jain of ARAI published in International Journal for Engineering Sciences and Computation, May 2019
- ▶ 'Effect of Fuel Injection Strategies and EGR on Biodiesel Blend in a CRDI engine' by Pathikrit Bhowmick & Dr. Nanthagopal (ARAI Academy Students), Dr. Ashok of VIT and Aatmesh Jain & Dr. K. C. Vora of ARAI published in Elsevier ENERGY - The International Journal - June 2019

Business Development

New Services & Capabilities

■ EV / HEV:

- Assessment of Electric Vehicles for compliance to FAME-II requirements
- Consultancy in Design, Development and Benchmarking of xEV
- Development of Electric Bus from conventional Diesel Bus
- Battery Packaging optimization of Electric Buses using CFD approach
- Dynamic testing of battery module as per UNECE R100
- Development, verification and validation of Hybrid and Electric (xEV) Automotive Systems using HIL
- Battery Packaging (Cells to Pack)
- Structural durability of Electric bike frame
- ADAS verification and validation
- Simulation for sizing of xEV drivetrain components
- Mobile Energy Storage Device for 2 & 3 Wheeler EVs
- Development of Battery Management Systems for L Category Vehicles
- Super-capacitor pack design from 3P to 4P configuration
- Testing and validation of Telecommunication related products

■ MATERIALS:

- Fuel Permeability testing of materials
- Testing of diesel engines NOX reduction agent AUS 32
- Testing of automotive cables of 600 V (AC) and 1000 V (AC)
- RoHS testing
- Analysis of Lubricants and Coatings in forging process
- Material Characterization for vehicle (BIW)

■ STRUCTURES & COMPONENTS:

- Certification of Vehicles / Engines as per Stage IV and Stage V norms for Agricultural Tractors, Construction Equipment and Combined Harvester
- Validation testing of seats as per ADR-34
- Occupant sensing and detection test
- Interior Fittings evaluation as per UNECE R21Annexure 8
- Durability testing of high speed Automatic Transmission
- Efficiency and durability testing of Transfer Case
- Efficiency mapping of Heavy Duty Axles
- Power loss test of EV driveline
- Vehicle energy audit for Light, Medium and Heavy Commercial Vehicles
- 3DOF in-lab simulation and performance evaluation of Elastomers used for Euro VI Engine
- Metro Seats validation for performance and durability as per international regulations
- Testing of Reverse Parking Assistance System (RPAS) as per AIS:145
- Taxi Roof Lamp testing
- Drop test of Advanced Light Helicopter Fuel Tank for EASA certification
- Sound quality assessment of musical instruments
- Noise barrier design for reducing road traffic noise
- Noise reduction of Air Handling Unit
- Generation of India specific data for machine learning process

■ SIMULATION:

- Climate Control CFD Simulation for Passenger Vehicle application
- Truck Trailer assembly design assessment using FEA technique
- Refrigerated Composite Load Body analysis
- Strength and vibration assessment of Folder Gluer Machine Frame structure using FE simulation
- Wire Rope Fence performance evaluation and validation using simulation

Brand Building

- ▶ Showcasing of capabilities and capacities at various exhibitions / symposiums, viz. Auto Expo, Defence Expo 2020, Light Weight Technology Summit 2019, Truck Trailer and Tyre Expo 2019, NuGen Mobility Summit 2019, Automotive e/E Technologies - Interactive Session for MSMEs, ITEC India 2019, Automotive Testing Expo India 2020 etc.
- ▶ 'Smart India Hackathon 2019 - Hardware Edition' at Pune centre, was co-organized by hardware edition along with NCL, IISER and ARAI



◀ Auto Expo Motor Show 2020 ▶



◀ Automotive Testing Expo India 2020 ▶

Technical Collaborations/Strategic Tie-ups

- ▶ MoU with BHEL: Design, technology development and testing projects in EV
- ▶ MoU with ANSYS: For setting up 'Centre of Excellence in Automotive Emerging Areas'
- ▶ MoU with Michelin India: To encourage knowledge-sharing, enhance general awareness of the transportation industry and to drive forward collaborations in automobile technology projects in India
- ▶ MoU with College of Engineering Pune (CoEP), Savitribai Phule Pune University, Pune and Cummins College of Engineering for Women: For conducting 1-year Post Graduate Diploma in Electric Mobility
- ▶ MoU with Blue Planet, South Korea: For cooperation in automotive areas like engine design and development; testing and calibration
- ▶ MoU with Madhya Pradesh Pollution Control Board (MPPCB): For a project on 'Emission Inventory and Source Apportionment Study for Bhopal City'
- ▶ Collaboration Agreement with Sweden India Transport Innovation and Safety Partnership (SITIS): In the area of Traffic Safety and Transport Innovation in India and Sweden. The other parties to this agreement include Automobile Companies, Academic Institutions and Swedish Transport Administration



◀ MoU with BHEL ▶



◀ MoU with College of Engineering Pune (CoEP), Savitribai Phule Pune University ▶

Workshops / Training Programmes Conducted

- ▶ 3-day Workshop on 'Preparedness for Forthcoming BS-VI Implementation and Emission Certification as per BS-IV for 2, 3 & 4 Wheelers" at Amritsar at the behest of Ministry of Road Transport and Highways (MoRTH)
- ▶ 3-day Workshop on 'Automotive Cylinder and Safety' at ARAI Pune for RTO Personnel
- ▶ 3-day Workshop on 'Role of After-treatment System for BS-VI Vehicles' at Visakhapatnam for RTO Personnel
- ▶ 3-day Workshop on 'Advance Engine Technologies to meet upcoming Emission Norms' at Kolkata for RTO Personnel
- ▶ 3-day Workshop on 'New Alternate Fuels including LNG and its Technologies for Engines' at Trivandrum for RTO Personnel
- ▶ 3-day Workshop on 'BS-IV and BS-VI Norms for Gaseous Fuel Vehicles and OBD Requirements' at Ahmedabad for RTO Personnel
- ▶ 3-day Workshop on 'Fire Safety for Vehicles' at Dehradun for RTO Personnel
- ▶ 3-day Workshop on 'First Generation and Second Generation Biofuels for Vehicles' at ARAI, Pune for RTO Personnel
- ▶ 1-day Training Program on 'Vehicle Road Load Data & Creation of Test File' at Hyderabad
- ▶ 3-day Training Program on 'Overview of Vehicle Safety & Certification of CNG/ LPG Conversions and New Regulations' at Ahmedabad for State Transport / Traffic Department Personnel
- ▶ 1-day Training Program on 'High Security Registration Plate (HSRP)' at Jaipur and Lucknow for State Transport / Traffic Department Personnel



◀ Training Program on 'High Security Registration Plate (HSRP)' ▶

Events

INAUGURATION OF CENTRE FOR GREEN MOBILITY

Centre of Excellence (CoE) for Green Mobility has been established at ARAI - Homologation and Technology Centre (ARAI - HTC) Chakan. This CoE for Green Mobility was inaugurated by Shri. Arjun Ram Meghwal, Hon'ble Minister of State, Ministry of Heavy Industries and Public Enterprises on 18th February 2020. The other dignitaries present on this occasion included Shri. C. V. Raman, President - ARAI and Senior Executive Director - Engg, Maruti Suzuki India Limited; Shri. Rajendra Petkar, Vice President - ARAI and Chief Technology Officer, TATA Motors Limited; and Smt. Rashmi Urdhwarshre, Director - ARAI. This centre focuses on development, validation and certification of Electric / Hybrid Electric Vehicles and Advanced Powertrain in order to address the increasing need for electrification of transportation and technology development for alternate energy.

Facilities for Electric / Hybrid Electric Vehicles and Systems:

The testing facilities for EV and associated components available at this centre include E-motor Test Beds, Battery Emulators, Battery Test System and Whole Vehicle Semi-anechoic EMC Chamber. Some of these facilities have been established under the support of DHI's FAME India Scheme. They can cater to various requirements of the industry like type approval testing & certification of Electric & Hybrid Electric Vehicles (xEVs); developmental projects on batteries, cells, simulation tools, vehicle endurance, motors and controllers, vehicle integration, etc.; research projects on xEVs, alternate battery materials, recyclability; skill development for designers, testing/ validation teams; and knowledge dissemination.

Facilities for Advanced Powertrain Development:

The facilities for advanced Powertrain development include transient test cells, which are equipped with state-of-the-art instrumentation for engine development. The transient test cells are with transient dynamometers (ranging from 220 kW to 600 kW) along with all necessary peripheral equipment and will cater to the certification / development testing of alternate fuel engines running on biodiesel, CNG LPG, diesel, gasoline and blends. They are suitable for development of engines meeting BS VI and beyond norms for automotive; TREM IV & V for agricultural application; BS IV & V for CEV; and CPCB IV & V for genset. Also, they are compliant with all relevant European and Indian Regulations and can simulate altitude ambient condition from sea level to 1600 meters on engine. The hydrogen test cell facility being set up at this centre will house a 350 kW transient dynamometer for development testing and certification of hydrogen engines and can test 4 to 6-cylinder engines for PCs, SUVs, LCVs and HCVs.



◀ Inauguration of CoE for Green Mobility by Shri. Arjun Ram Meghwal, Hon'ble Minister of State, Ministry of Heavy Industries and Public Enterprises ▶

INAUGURATION OF LABORATORIES AT KNOWLEDGE CENTRE

ARAI through its learning centre conducts undergraduate, postgraduate and doctorate programs in collaboration with various universities. In order to provide hands-on experience to the students of these programs, ARAI has added following two dedicated laboratories at its ARAI - Forging Industry Division (ARAI - FID), Chakan facility during the year.

IC Engine Laboratory:

IC Engine laboratory was inaugurated on 3rd February 2020 by Mr. Rajendra Petkar, Chief Technical Officer, Engineering Research Center, TATA MOTORS LTD. & Vice President - ARAI. It is equipped with containerized Test Cell and has latest equipment like AC Dynamometer, Fuel Flow Meter, Air Flow Meter, Coolant Conditioning System, Air Handling Unit and Data Acquisition System. These facilities will enable the students to conduct experiments like full & part throttle performance of diesel and gasoline engines; heat rejection test; friction power measurement; morse test to measure mechanical efficiency of the engine; transient response test and governing test.

Noise & Vibration Laboratory:

Noise & Vibration laboratory was inaugurated on 25th June 2019 by Mr. Paul Mascarenas, President - SAE International, USA in presence of Prof. Dr. M. L. Munjal from Indian Institute of Science, Bengaluru. It is equipped with facilities like Acoustic Enclosure, Impedance Tube, NVH Instruments & Sensors and DC Power Supply. These facilities will enable the students to conduct experiments like measurement of sound absorption coefficient; sound power level of an electric motor and transmission loss of a sound absorbing material; frequency domain analysis for an electric motor; generating sound beating phenomenon at different frequencies and finding the beating frequency; generating the phenomenon of active noise cancellation at different frequencies of sound; and demonstration of NVH measuring instruments.



◀ Inauguration of IC Engine Lab ▶



◀ Inauguration of Noise & Vibration Lab ▶

SUPPORTING SAEINDIA ACTIVITIES

ARAI is associated with SAEINDIA's wide spectrum of activities, which are carried out for the benefit of practicing engineers, engineering students and school children. ARAI supports SAEINDIA Western Section's (SAEI WS) various activities, viz. training and educational programs, workshops and lecture series for enhancing knowledge of mobility practitioners. During the year, ARAI supported following activities of SAEINDIA.

Eminent Speaker Lectures - Tech Talk Series

- ▶ 'Rollcage Design & Suspension Mounting on All Terrain Vehicle' by Mr. Sanjay Nibandhe, Deputy Director - ARAI for student members of Birla Vishvakarma Mahavidyalaya (BVM) Engineering College, Vallabh Vidya Nagar, Gujarat
- ▶ 'Introduction to India Emission Regulations & Technologies to meet them' by Mr. Ramesh Pasarija for student members of Birla Vishvakarma Mahavidyalaya (BVM) Engineering College, Vallabh Vidya Nagar, Gujarat
- ▶ 'Automobile Validation Process' by Mr. Sanjay Nibandhe, Deputy Director - ARAI for student members of LD College of Engineering and other Colleges in LD College of Engineering, Ahmedabad
- ▶ 'Introduction to India Emission Regulations' by Mr. Ramesh Pasarija for student members of LD College of Engineering and other Colleges in LD College of Engineering, Ahmedabad
- ▶ 'E-Mobility Regulations and FAME-II' by Mr. Manoj Desai, General Manager - ARAI at SAEINDIA Aurangabad Division
- ▶ 'Design and Performance Optimization of Batteries for Electric Vehicles' by Dr. Vineet Dravid, Managing Director, COMSOL Multiphysics Pvt. Ltd. at ARAI, Kothrud
- ▶ 'Engine Management System' by Mr. Sanjeev Gothekar, Deputy General Manager - ARAI at A. P. Shah Institute of Technology, Thane
- ▶ 'Electric Mobility - India Overview' by Mr. A. A. Deshpande, Senior Deputy Director - ARAI
- ▶ 'Safety Road Map and Vision Zero Policy Initiative' by Mr. A. V. Mannikar, Senior Deputy Director - ARAI
- ▶ 'AUTOSPARX - 2019', first technical event of SAEINDIA and ARAI Collegiate Club, was organized for students on 22nd November 2019 at ARAI-FID, Chakan under the convenorship of Dr. K. C. Vora, Senior Deputy Director - ARAI. The event was inaugurated by Mr. Sanjay Nibhande, Deputy Director - ARAI and Chairman - SAEINDIA Western Section; along with Mr. Vinay Mundada, Senior Automotive Consultant. The theme of event was "SAFE, SMART & SUSTAINABLE MOBILITY" and it covered Tech-Talk Lectures (in the areas of automotive electronics, electric & hybrid vehicles and automotive safety and crash) and Tech-Activities (auto quiz, creative ideas and automotive styling).



▶ Tech Talk Series on 'Electric Mobility - India Overview' ▶



▶ Tech Talk Series on 'Safety Road Map and Vision Zero Policy Initiative' ▶

Workshops

- ▶ 'Electronics Community Confluence' organized at Pimpri Chinchwad College of Engineering
- ▶ 1-day seminar on 'Alignment of IP with Strategies of Aspiring Businesses from India's Automotive Sector' was jointly organized by Ministry of Electronics and IT (MeitY); The European Patent Office in cooperation with the European Business and Technology Centre (EBTC); SAEINDIA; and ARAI.
- ▶ SAEINDIA Professional Development Program on 'Advance Powertrains for Mobility and Power Generation Applications' was held at Pune. Dr. S. S. Ramdasi, Deputy Director - ARAI was the convener for this event.

Other Activities

- ▶ ARAI sponsors AWIM activity in Pune and as part of this, three schools were supported with volunteers from ARAI to train the school children.
- ▶ AWIM Pune Olympics was held at John Deere India Office, Pune.
- ▶ AWIM Glider Training - a pilot training program to introduce the toy to the teachers and volunteers, was organized at ARAI-FID, Chakan for Western Section participants.
- ▶ TIFAN (Technology Innovation Forum for Agricultural Nurturing) qualifying round was organized at Vishwakarma Institute of Technology, Pune.



◀ AWIM Activity ▶



◀ AWIM Glider Training ▶

Knowledge Centre

ARAI undertakes knowledge dissemination and skill development activities through its Learning Centre (LC), Training Centre (TC) & Library. This includes training and educational programmes to enhance human resource skills for meeting the growing needs of automotive industry. ARAI carries out these activities at ARAI - Forging Industry Division (ARAI - FID), Chakan.

LEARNING CENTRE

Learning Centre conducts undergraduate, postgraduate and doctorate programmes with specialization in Automotive Engineering through collaborations with various universities. It has tie-ups with Indian Universities, viz. VIT University (Vellore), VELTECH University (Chennai), College of Engineering (Pune) & Christ University (Bengaluru); and University of Alabama, USA. This year, M. Tech program with VELTECH University on Automotive Engineering with specialization in I. C. Engines was revised to two programs with specialization in Powertrain Engineering and Electric & Hybrid Vehicles. Also, a MoU was signed with three institutes, viz. Savitribai Phule Pune University - Department of Technology (SPPU-DOT); College of Engineering, Pune (COEP); and Cummins College of Engineering for Women (COEW), Pune for commencing Post Graduate Diploma in Electric Mobility. Brief summary of the joint programmes conducted is given below.

UNIVERSITY	SPECIALIZATION
VIT University, Vellore	B. Tech. in Mechanical Engineering with specialization in Automotive Engineering
	M. Tech. in Automotive Engineering
VEL TECH University, Chennai	B. Tech. in Mechanical Engineering with specialization in Automotive Engineering in association with GARC, Chennai
	M. Tech. in Automotive Engineering with specialization in Powertrain Engineering
	M. Tech. in Automotive Engineering with specialization in Electric and Hybrid Vehicles
College of Engineering, Pune	M. Tech. in Automotive Technology (Syllabus includes advanced and current topics like Automotive Intelligence and HEV)
Christ University, Bengaluru	B. Tech. in Automobile Engineering
Alabama Birmingham, USA	M. S. in Mechanical Engineering with Automotive Engineering Emphasis
Savitribai Phule Pune University -Dept. of Technology	Post Graduate Diploma in Electric Mobility
College of Engineering, Pune	
Cummins College of Engineering of Women, Pune	

The various M. Tech project areas of students include Engines (Testing, Performance, Simulation, Calibration, Emission & After Treatment); Hybrid Electric Powertrain; NVH; CAE; Crash Analysis; Vehicle Design & Dynamics; Materials; Alternative Fuels; Electric Vehicle; and Advanced Driver Assistance Systems. During the year, facilities like multi-purpose engine test cell, work-stations for engine simulation & CAE lab, automotive engineering system lab and development of NVH & Silent room were carried out, in addition to setting up of a Simulation Lab. These facilities are for providing students with hands-on training, experience and academic projects.



◀ IC Engine Lab ▶



◀ Automotive Engineering System Lab ▶

Further, under the support of Department of Heavy Industry, training programs for creating awareness in the area of Electric Mobility were organized at six engineering colleges situated in western and central parts of India. These programs were attended by 1183 students and faculty members. Also, drawing and essay competitions were conducted as part of these programs.

TRAINING CENTRE

Training Centre organizes Proficiency Improvement Programs (PIPs) & Domain Training Programs (DTPs). During the year, 35 PIPs & 4 DTPs were organized, wherein lectures were given by ARAI personnel, academicians and eminent industry experts, including speakers from abroad. These PIPs & DTPs had a participation of over 1450 delegates and were conducted in the following areas of automotive engineering.

Proficiency Improvement Programs (PIPs)

- ▶ Electric & Hybrid Vehicles
- ▶ Engine Design and Development
- ▶ Vehicle & Engine Testing
- ▶ Metallurgy for Non-metallurgists
- ▶ Shared Mobility
- ▶ Emergence of Lithium-ion Batteries in the Automobile Sector
- ▶ Automotive NVH
- ▶ Automotive Engineering
- ▶ Noise Pollution: Measurement & Control
- ▶ Powertrain Engineering

- ▶ E-mobility & FAME II Requirements
- ▶ Forging Technology
- ▶ Engine Testing & Certification
- ▶ Automotive Styling
- ▶ Hybrid Electric Vehicle (HEV)
- ▶ Virtual Testing for Robust Calibration (for upcoming emission norms- BS VI, RDE, stage IV/V, CPCB 4+, etc.)
- ▶ ECU & Diagnostics
- ▶ Failure Mode & Effect Analysis (FMEA)
- ▶ Crash Safety of Vehicle (including Electric Vehicle)
- ▶ Fuel Cell Technology (Blended)
- ▶ Connected & Autonomous Mobility
- ▶ BS- VI Technology, Regulations & Implementation for Automotive Vehicles
- ▶ Science behind Vehicle Dynamics
- ▶ Electric and Hybrid Vehicle Modeling & Simulation
- ▶ Electric Vehicles Development, Validation & Certification
- ▶ Internal Combustion Engine
- ▶ Failure Analysis (including Auto & Engine components)
- ▶ Benchmarking: An Engineered Approach
- ▶ Advances in Plastic Moulding
- ▶ Fluid Connections for Automotive (inclusive of Electric Vehicles)
- ▶ Automotive Sensors & Actuators
- ▶ Real Driving Emission
- ▶ Noise & Vibration application in Automotive Engineering
- ▶ Simulation for Electric & Hybrid Vehicles
- ▶ Engine Emission & Control for BS VI & Beyond

Domain Training Programs (DTPs)

- ▶ Testing of Seating Systems
- ▶ Automotive Testing and Material Characterization
- ▶ Fundamental of Automotive Electricals & Electronics
- ▶ Automotive NVH

Online E-modules

- ▶ Reliability Engineering
- ▶ Engine Electronics & Management Systems
- ▶ Fuel Cell Technology
- ▶ Real Driving Emissions (RDE)



◀ *PIP on Emergence of Lithium-ion Batteries in the Automobile Sector* ▶



◀ *PIP on Electric Vehicles Development, Validation & Certification* ▶

LIBRARY

The library at Knowledge Centre, Pune is fully automated one having specific collection in automotive and related subjects in Kothrud, Pune. Also, a new library has been set up to provide information services at the Knowledge Centre at ARAI - FID, Chakan. These libraries serve automotive engineering professionals, faculty, students and various government organizations in automotive and related subjects. The collection at these libraries includes over 75000 SAE technical papers, more than 25000 books and standards, around 1600 project reports, over 500 SAE special publications, more than 450 E-Books and 8 Kindle E-Book Readers. Also, during the year, over 36 journals were subscribed to.

In order to capture, organize, preserve and disseminate knowledge ARAI Digital Library has been developed and it has a collection of over 16000 documents. It includes Conference Proceedings, SIAT Keynote & Technical Papers, Seminar Papers, Staff Publications, ARAI Updates, Automotive Abstracts, etc. which can be accessed by staff and students through the campus intranet. The Automotive Abstracts, published every month since 1975, provided updates on the latest events and happenings in the automotive industry. It includes abstracts of articles published in most of the leading Journals/ Periodicals on automotive technology and international symposiums such as IMechE, FISITA, ISATA, SIAT, etc. It also includes auto news, techno scan, IPR scans, book reviews, forthcoming events etc.

ARAI is planning to publish a new journal focusing on research in the field of automotive technology, titled "Mobility Technology Journal: A Journal of Automotive Research Association of India (JARAI)". The primary objective of this journal is to encourage research by disseminating study outcomes in automotive engineering and its sub-areas. This journal is targeted at the scholars, academicians and professionals associated with the automotive industry sector

Homologation and Technology Centre (ARAI – HTC), Chakan

ARAI - Homologation and Testing Centre (ARAI - HTC) caters to the industry's requirements in the areas of Passive Safety, Powertrain Engineering, Fatigue & Materials and Transmission & Gear Box testing. During the year, the facilities at ARAI-HTC have been augmented further with establishment of Centre of Excellence (CoE) for Green Mobility. The facilities at this CoE for Green Mobility are for certification & testing assignments and development projects in the areas of Electric / Hybrid Electric Vehicles and Systems and advanced Powertrain Development. Some of the key activities conducted at ARAI - HTC during the year are given below.

- ▶ Durability testing of High Speed Automatic Transmission.
- ▶ Developmental testing of crash sensing Emergency Call device (e-call device) and customization for Indian vehicle fleet.
- ▶ Developmental testing of aluminum foam filled automotive bumper beams for AMPRI, Bhopal, a premier research institute under CSIR.
- ▶ Crash tests, Sled tests and Head Impact tests.
- ▶ Addition of new pair of instrumented Hybrid-III 50th percentile dummies which will help in reducing the lead time for conducting customer specific crash tests
- ▶ Addition of two new 3D portable Arm Coordinate Measurement machines which will help in reducing exhaustive measurement time required for pre-test and post-test CMM measurements on crash test vehicles.
- ▶ Addition of advanced pedestrian protection test tool - Flex-PLI: This advanced pedestrian Leg form impactor offers more measurement points for assessment of leg injuries to pedestrians under impact conditions. Also, it is a harmonized test tool and included under GTR No.9 Ph.2 & UN Regulation No. 127.
- ▶ Addition of special crash sensors and data acquisition systems to offer more number of data acquisition channels during crash test.
- ▶ Sensor library has been augmented with the inclusion of special crash sensors such as crush element sensor, door-opening assessment sensor, battery temperature monitoring sensor, door cavity pressure sensor, and strain gauges for crash test application.
- ▶ Procurement of Miniature On-board High Speed Camera System: Offers high definition images of areas inside the vehicle with less illumination
- ▶ Organizing of customer meet 'SAMVAAD'
- ▶ Some of the other activities carried out during 2019-20 included tree plantation, Swachhtha Pakhwada Abhiyan, Awareness Session on Industrial Health & Epidemic Corona Virus (COVID-19) etc.



Developmental Testing of Aluminum Foam filled Automotive Bumper Beam



Organizing of Customer Meet 'SAMVAAD'

▶ **Independent Auditor's Report**

▶ **Annual Statement of Accounts**

Independent Auditor's Report

To -
The members of
AUTOMOTIVE RESEARCH ASSOCIATION OF INDIA

OPINION -

We have audited the financial statements of AUTOMOTIVE RESEARCH ASSOCIATION OF INDIA, PUNE ("ARAI") which comprise the Balance Sheet as at March 31, 2020, and the Income and Expenditure Account for the year then ended, and notes to the financial statements, including a summary of significant accounting policies. In our opinion, the accompanying financial statements of the entity are prepared, in all material respects, in accordance with accounting principle generally accepted in India.

BASIS OF OPINION-

We conducted our audit in accordance with the Standards on Auditing (SAs) issued by ICAI. Our responsibilities under those Standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the entity in accordance with the Code of Ethics issued by ICAI and we have fulfilled our other ethical responsibilities in accordance with the Code of Ethics. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

EMPHASIS OF MATTER -

We draw your attention to Note no. 11 in Notes to Accounts, which describes the management's evaluation of impact of uncertainties related to COVID-19 and their assessment of recoverability and carrying value of its assets comprising of tangible assets, inventories and other current assets as at the Balance sheet date. Our opinion is not modified in respect of this matter.

RESPONSIBILITIES OF MANAGEMENT AND THOSE CHARGED WITH THE GOVERNANCE FOR THE FINANCIAL STATEMENTS -

Management of ARAI is responsible for the preparation of the financial statements in accordance with relevant laws as applicable and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error. In preparing the financial statements, management is responsible for assessing the entity's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the entity or to cease operations, or has no realistic alternative but to do so. Those charged with governance are responsible for overseeing the entity's financial reporting process.

AUDITORS' RESPONSIBILITIES FOR THE AUDIT OF FINANCIAL STATEMENTS -

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

For M/s Gunwani & Kolapkar,
Chartered Accountants
(Firm Registration No.128698W)

Ghanasham Ranade
(Partner)
(Membership No. 100151)
Pune, Dated 28th August 2020

Balance Sheet As On 31st March 2020

(RS IN LAKH)

PARTICULARS	SCH NO	AS ON		AS ON
		31-03-2020		31-03-2019
SOURCES OF FUNDS				
1. GENERAL & OTHER FUNDS				
A) GENERAL FUND	1	1,02,788.07	82,360.63	
B) R & D RESERVE FUND	2	28,076.77	26,339.33	
C) REPLACEMENT OF EQUIPMENT/MACHINERY FUND	3	12,829.57	12,018.22	
D) ENDOWMENT FUND	4	3.25	3.00	
E) ARAI ACADEMY ALUMNI ASSOCIATION FUND	5	0.00	0.00	1,20,721.18
2. PROJECT FUNDS (NET)	6		1,180.39	1,411.91
3. CURRENT LIABILITIES AND PROVISIONS	7		15,748.89	12,196.03
TOTAL			1,60,626.96	1,34,329.12
APPLICATION OF FUNDS				
1. FIXED ASSETS	8		77,273.73	55,858.33
2. CURRENT ASSETS, DEPOSITS AND ADVANCES				
A) INVENTORIES	9(A)	23.83	19.91	
B) SUNDRY DEBTORS	9(B)	4,994.59	4,182.23	
C) DEPOSITS, CASH & BANK BALANCES	9(C)	71,627.06	68,680.15	
D) ADVANCES AND OTHER ASSETS	9(D)	6,391.29	5,272.04	
E) SUNDRY DEPOSITS	9(E)	316.46	316.46	78,470.79
TOTAL			1,60,626.96	1,34,329.12
NOTES TO THE ACCOUNTS	14			

Neelkanth V Marathe
Officiating Director

C V Raman
President

Rajendra Petkar
Vice President

AS PER OUR
REPORT OF EVEN DATE
FOR M/S GUNWANI AND KOLAPKAR
CHARTERED ACCOUNTANTS
Firm's Reg. No. 128698W

GHANASHAM RANADE
PARTNER
Membership No. 100151

Date : 28th August 2020
Place : Pune

Income And Expenditure Account For The Year Ended 31st March 2020

(RS IN LAKHS)

PARTICULARS	SCH NO	YEAR ENDED 31-03-2020	YEAR ENDED 31-03-2019
INCOME			
OPERATIONAL INCOME	-	36,338.72	31,846.19
ANNUAL MEMBERSHIP SUBSCRIPTION (NET)	-	584.05	615.82
SIAT INCOME	-	0.39	1,084.34
FUNDS TRANSFERRED FROM R&D RESERVE FUND	-	162.07	110.80
INTEREST	10	4,545.41	4,174.60
OTHER INCOME	11	244.26	366.87
TOTAL		41,874.89	38,198.62
EXPENDITURE			
OPERATIONAL EXPENSES	-	3,793.90	3,518.58
ARAI R&D PROJECTS	-	162.07	110.80
SALARIES & OTHER ALLOWANCES	12	16,189.08	13,801.64
EMPLOYEE RELATED EXPENSES	-	360.19	366.08
ESTABLISHMENT EXPENSES	13	4,979.03	4,316.35
DEPRECIATION	-	4,973.52	3,852.20
LESS: DEPRECIATION ON GOVT. FUNDED ASSETS		2,359.00	1,291.57
SIAT EXPENSES	-	40.10	443.63
EXCESS OF INCOME OVER EXPENDITURE		13,736.00	13,080.91

Income And Expenditure Account For The Year Ended 31st March 2020

(RS IN LAKHS)

PARTICULARS	SCH NO	YEAR ENDED 31-03-2020		YEAR ENDED 31-03-2019
APPROPRIATION				
A) INTEREST ON EARMARKED FUNDS TRANSFERRED TO RESPECTIVE FUNDS				
- R & D RESERVE FUND		1,899.50		1,414.34
- REPLACEMENT OF EQUIPMENT/MACHINERY FUND		811.35	2,710.85	660.19
B) SIAT SURPLUS/(DEFICIT) TRANSFERRED TO GENERAL FUND			(39.71)	640.71
EXCESS OF INCOME OVER EXPENDITURE (NET)			11,064.85	10,365.67
TOTAL			41,874.89	38,198.62
NOTES TO THE ACCOUNTS	14			

Neelkanth V Marathe
Officiating Director

C V Raman
President

Rajendra Petkar
Vice President

AS PER OUR
REPORT OF EVEN DATE
FOR M/S GUNWANI AND KOLAPKAR
CHARTERED ACCOUNTANTS
Firm's Reg. No. 128698W

GHANASHAM RANADE
PARTNER
Membership No. 100151

Date : 28th August 2020
Place : Pune

ARAI Organisation Chart 2019-20



Ms. Rashmi Urdhwarshetkar
Director - ARAI
director@araiindia.com

RESEARCH & DEVELOPMENT DIVISION 1

Structural Dynamics Lab;
Environment Research Lab;
Technology Group - Till 31/12/2019



Mr. M. R. Saraf
Senior Deputy Director
mrsaraf.sdl@araiindia.com

Structural Dynamics Lab;
Purchase w.e.f. - 3/1/2020



Mr. V. V. Shinde
Deputy Director
shinde.sdl@araiindia.com

Engineering Design & Simulation,
Noise Vibration & Harshness
Lab w.e.f. - 13/8/2019



Mr. R. S. Mahajan
Deputy Director
mahajan.eds@araiindia.com

RESEARCH & DEVELOPMENT DIVISION 2

Powertrain Engg.
Prototype Mfg. Dept.



Mr. N. V. Marathe
Senior Deputy Director
nvmarathe.ed@araiindia.com

Automotive Electronics Dept.



Mr. A. A. Deshpande
Senior Deputy Director
deshpande.aed@araiindia.com

In Charge Technology
Group w.e.f. - 3/1/2020



Ms. Ujjwala Karle
General Manager
karle.tg@araiindia.com

In Charge Environment
Research Lab w.e.f. - 13/8/2019



Dr. S. S. Thipse
Senior Deputy Director
thipse.cdl@araiindia.com

HOMOLOGATION DIVISION

Vehicle Evaluation Lab.,
Homologation Management
& Regulation



Mr. A. A. Badusha
Senior Deputy Director
badusha.vel@araiindia.com

Safety & Homologation Lab.,
Passive Safety Lab.



Mr. A. V. Mannikar
Senior Deputy Director
mannikar.shi@araiindia.com

Emission Certification Lab.



Mr. K. Srinivas
Senior Deputy Director
srinivas.ecl@araiindia.com

Homologation & Technology
Centre & FID, Chakan



Mr. S. S. Nibandhe
Deputy Director
nibandhe.cp@araiindia.com

SERVICE DIVISION

Business Development &
Corporate Planning,
Inspection & Maintenance Project Cell



Mr. N. B. Dhande
Senior Deputy Director
dhande.dls@araiindia.com

Academy &
Knowledge Centre



Dr. K. C. Vora
Senior Deputy Director
vora.pga@araiindia.com

Central Maintenance Cell



Ms. M. S. Mainkar
Senior Deputy Director
mainkar.ec@araiindia.com

Human Resource Management
& Administration



Dr. M. V. Uchgaonkar
Senior Deputy Director
uchgaonkar.pah@araiindia.com

Finance & Accounts,
Stores



Mr. A. B. Bhide
Deputy Director
bhide.acc@araiindia.com

Information, Technology &
Management w.e.f. - 3/1/2020



Ms. Medha Jambhale
Deputy Director
jambhale.sdl@araiindia.com

Quality Management Department,
Calibration Lab.



Mr. V. K. Jadhav
General Manager
jadhav.gmd@araiindia.com

Infrastructure Development



Mr. C. S. Mukhedkar
General Manager
mukhedkar.pas@araiindia.com

Governing Council
Secretariat & Legal



Mr. S. P. Dabir
General Manager
dabir.gc@araiindia.com

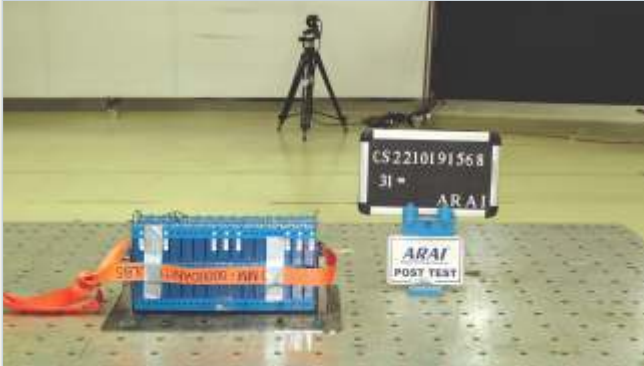
Governing Council
Secretariat & Legal



Ms. P. M. Dhare
Deputy General Manager
Secretary to the Governing Council
dhare.acc@araiindia.com

The Automotive Research Association of India

New Services & Capabilities



Dynamic Testing of Battery Module as per UNECE R100



Validation Testing of Seats as per ADR 34



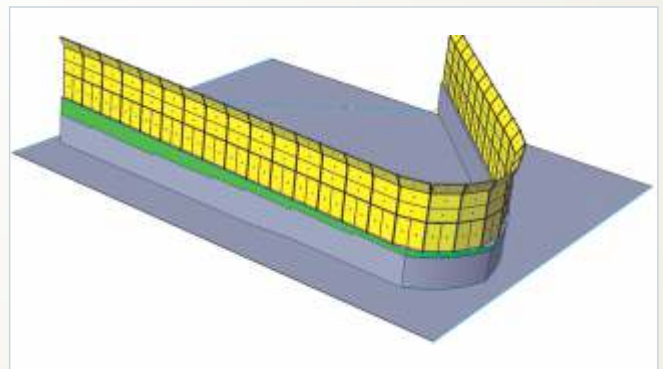
Interior Fittings evaluation as per UNECE R21



Drop Test of Advanced Light Helicopter Fuel Tank



High Speed Durability Testing of Automatic Transmission



Noise Barrier Design for Road Traffic Noise Reduction



Sound Quality Assessment of Musical Instrument



Noise Reduction of Air Handling Unit



ARAI

Progress through Research

The Automotive Research Association of India

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