

श्री डॉ. एम. राजन



Dr. KM Rajan

Dr. K. M. Rajan, Director
ARDE, PUNE
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ARDE, PUNE
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Dear Prof. Indranil Manna,

At the outset I wish to thank you for making available services of Prof AK Ghosh, Dept. of Aerospace Engg during the recently conducted Flight Trial of 214mm PINAKA MK-II Rockets at Proof & Experimental Establishment (PXE), Balasore from 27th to 30th May 2014. Prof Ghosh has been associated with this project right from its inception and also been member of PEER and various Design review committees. This is one of the most prestigious projects of our Establishment and the recently concluded flight trial was very crucial for the rocket system being developed by us totally indigenously.

Three trials were conducted prior to this flight trial. During these trials, although, rocket propulsion system performed as expected, there had been issues related to dynamic stability of the rockets resulting in inconsistency as well as at times underperformance. Prof Ghosh has been associated right from 1st trial and he was instrumental in identifying these problems in a very systematic & phased manner. Crux of the problem had been out-of-plane moment & peculiar roll-reversal characteristics exhibited by curved wrap-around-fins used for stabilization of rockets; this was in fact the outcome of on-site analysis of the recorded flight data carried out during the 1st flight trial under the guidance of Prof Ghosh. These findings were confirmed during the next day's flight trial conducted on innovative recommendations of Prof Ghosh, wherein rockets with brake rings were fired to confirm the hypothesis.

During the second & third flight trials attempts were made to solve the problem by modifying the in-use 4-fin WAF design and evolving a new 6 curved WAF design, wherein, while, one of the rockets achieved a maximum range of 65km under prevailing meteorological conditions, the same was not repeated by the other rockets fired on the same occasion. Detailed analysis of radar tracked & telemetered data was carried out by our team under the guidance of Prof Ghosh. It revealed that the problem of out-of-plane moment of curved WAF has been resolved with these modifications. However, a close scrutiny of roll-time & acceleration-time data recorded for all rocket flights indicated that the issues related to roll-reversal with possibility of roll-pitch lock in has resulted in the inconsistent performance of the rockets.

Congratulations to Prof. Ghosh.

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Congratulation Prof. Ghosh.
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Through: HoD, AE
Prof. AK Ghosh

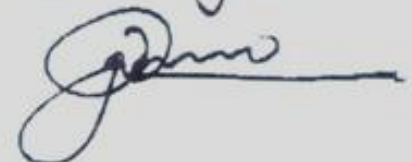
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Prof Ghosh then suggested several alternative design modifications with emphasis on possibilities of use of 6 planar-flat wrap-around fins for the stabilizer. A design with planar fins was evolved by ARDE design team, stability and other aeroballistics aspects of which were reviewed by a Design Review committee chaired by Dr VG Sekaran, DG (MSS) of which Prof Ghosh was an important specialist-expert member. It indeed gives me great pleasure to share with you, namely, the outcome of the flight trial that six rockets with this finalized innovative design were test fired and achieved consistently a maximum range of 61km under prevailing meteorological conditions. This is a land mark achievement for ARDE and a Golden Moment for Artillery Rocket Development by ARDE / DRDO.

I, therefore, wish to put on record our appreciation for the most valuable contributions made by Prof Ghosh during the progress of the project, especially, during finalization of stabilizer fin geometries, conduct of all 4 flight trials, rigorous analysis of flight data and guiding ARDE team throughout. I once again whole heartedly thank you for permitting Prof Ghosh to participate and contribute in our developmental activities and I am sure that this association would continue in future also.

With best wishes.

Sincerely Yours



Prof. Indranil Manna
Director
Indian Institute of Technology
KANPUR – 208 016