Significance of the McDonnell Aircraft Corp. (Boeing) location in reference to the Vertical Flight Heritage Site Award Nomination and V/STOL History in general

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Objective of the Supporting Material

The following award nomination **categories** (or numbered items) are covered in this document; which serve as supporting material for the *Vertical Flight Heritage Site* nomination form:

11. Detailed Summary of Site Significance
12. Maps of Site
13. Drawings of Site
14. Photos of Significance
15. Articles Concerning Site
16. References

Note: This outline is not intended as a detailed or complete history of McDonnell Aircraft Corp. or its Helicopter Division. In addition, it is not the intention of the nominator to capture the history of Platt LePage, Hughes Aircraft Co., MD Helicopters, or Boeing Helicopters. Those histories are well documented in other sources. The same can be said about the incredible work on the McDonnell Douglas AV-8B *Harrier* II V/STOL powered lift jet aircraft and its derivatives.

11. Detailed Summary of Site Significance:

In 1943, the McDonnell Aircraft Corporation (MAC) established a helicopter division to embark on new and experimental helicopter designs that eventually advanced the State-of-the-Art in ways that seem to be quite challenging even today. Mr. James Smith McDonnell, Jr., MAC's founder and its driving force, was able to gather, hire and train helicopter theorists and specialists from Pennsylvania and later post war Germany to help him reach his helicopter design and manufacturing goals. The people he was able to group together were leaders in the field of side-by-side rotors and tip jet helicopters. No less than three distinct helicopter configurations were created and developed under Mr. McDonnell leadership.

These wartime helicopter pioneers were able to design, build and test rotorcraft that stand today as a testament of their ingenuity, dedication and hard work. After a hiatus of 24 years, MAC continued helicopter design and production when the company acquired Hughes Helicopters, Inc. in 1984. Today, the legacy of McDonnell Aircraft carries on under the direction of parent company Boeing.

How McDonnell Aircraft Earned its Rotor Wings

Mr. McDonnell, (affectionally known by his employees and friends as “Mr. Mac” or “Old Mac”) was determined to be a player on the new technology of rotary wings- started earlier by pioneers such as Cierva, Weir, Pitcairn, Bréguet, Dorand, Focke, Kellett, Flettner, Kamov, Hiller, Sikorsky, and in the final years of World War Two, Piasecki and Platt-LePage. It was Platt-LePage and his work on the side-by-side rotor configuration that caught the attention of Mr. McDonnell. Influenced by the German exploits of Hanna Reitsch and her dramatic Focke-Wulf Fw 61 V2 demonstration flights in 1938, Platt Le-Page convinced the U.S. Army that helicopters were or were about to be an essential part of a modern military. German use of these vehicles in logistical and surveillance operations had already demonstrated their value in war, albeit in a limited capacity due to other wartime priorities.

In July 1940, Platt-LePage received a contract from the Army Air Corps to build a prototype of a side-by-side rotor helicopter, the XR-1. At the time, Platt-LePage was based in Eddystone, Pennsylvania, and it was there that Mr. McDonnell sent his engineers and began his company investment on helicopters. In 1942 he arranged for a group of McDonnell Aircraft engineers headed by his old friend and collaborator Constantine Zakhartchenko to join Platt-LePage and learn the art of helicopter design and construction. It would be immensely unfair to ignore the accomplishments of Platt-LePage and his team of helicopter pioneers; but their story is better told elsewhere. It suffices to say that the close collaboration between Platt-

LePage and McDonnell engineers gave birth to one of the most advanced helicopters of the immediate post war period, the McDonnell XHJD-1 *Whirlaway* side-by-side helicopter (Figure 1).

Figure 1. McDonnell XHJD-1 *Whirlaway* side-by-side rotors helicopter (Courtesy of Boeing)

It was in this aircraft that McDonnell sharpen the skills of its helicopter division engineers due to the issues such complex rotary wing aircraft entails.

The XHJD-1 was intended a first of many U.S. Navy high performance rotorcraft, but defense drawdowns and other priorities left MAC without a production contract. Nevertheless, the seed of progress was already laid within the newly formed helicopter division; which soon was joined by two brilliant German technologists: Dr. Kurt Hohenemser, and Friedrich von Doblhoff; both refugees of post war Germany.

Tip-Jet Helicopters Wonders

Dr. Hohenemser brought with him a strong theoretical foundation that MAC needed for its future high-speed helicopters, and F. von Doblhoff brought his vast experience on tip-jet helicopters; which at the time (lacking today's engineering tools) was heavily dependent on experimentation and trial and error engineering. Their expertise was directed to a new (and briefly tried) novel form of helicopter propulsion: Tip-Jet / Ramjet Rotors. The first ramjet powered tip-jet rotor helicopters were built and tested in St. Louis under the guidance of Mr. von Doblhoff. Such craft attracted a vast amount of interest and media attention at the time; but no orders followed (Figure 2 and 3).

Figure 2. McDonnell XH-20 *Little Henry* (Courtesy of Boeing)

McDonnell Aircraft continued its involvement in helicopter research which resulted in the development of two very significant rotorcraft, the XV-1 *Convertiplane*, and the Model 120.

Figure 3. McDonnell Model 79 *Big Henry* (Courtesy of Boeing)

The XV-1 was a tip-jet compound helicopter capable of unloading its rotor, and fly at very high speeds (Figure 4). In fact, it was the first rotorcraft to exceed the 200 miles per hour mark.

Figure 4. McDonnell XV-1 *Convertiplane* (Courtesy of the Erwin J. Bulban collection, via Jay Miller)

The Model 120 was a more compact derivative of the XV-1 (it used the tip-jet rotors from the XV-1 prototypes) and it was single piloted. This diminutive helicopter demonstrated enormous

potential as a very capable "Sky Crane" helicopter (Figure 5). Unfortunately for McDonnell Aircraft, orders for these two high performance machines never materialized.

Figure 5. McDonnell Model 120 (Courtesy of Boeing)

Huge investments were made on Jet-Tip Rotors Hot Whirl Rigs (Figure 6 and References 1, 2 and 9), model testing and wind tunnel testing, and as a result, much was learned on this new and untried technology. In the case of the hot whirl test stands, they were constructed in support of the XV-1 contract and contracts for larger helicopters such as the U.S. Navy XHCH-1 *Sky Crane* (or *Cargo Unloader*) helicopter.

These facilities were operated in a former U.S. Navy airfield and training facility named Smartt Field. The field was located 16 miles NNW of the McDonnell Aircraft main plant, and provided a means of safe flight testing and ground testing away from populated areas (surely noise abatement was also a consideration). The MAC hot whirl rig was a unique facility and only the Fairey hot whirl rigs in White Waltham and Boscombe Down, United Kingdom, could equal them (these rigs were being operated by Fairey and McDonnell Aircraft around the same time; that is, early 1950s). The author has not been able to find historical references that indicate that collaboration between the companies took place during the design phase of the rigs.

Boeing still operates a radar test range at Smartt Field, but it appears from a brief review of online satellite imagery that very little remains of the old test stand (except for perhaps its concrete pads).

Figure 6. The MAC designed and built hot whirl test stand at Smartt Field, north of St. Louis (Courtesy of Bob Head via Ken Bartie, Boeing).

Conclusion

It is easy to dismiss MAC helicopters as nothing more than unsuccessful experiments; however, this could not be further from the truth. The lessons learned on these vehicles drove the evolution process of helicopter engineering which today has reached a high level of maturity. Configurations such as the side-by-side and tip jet rotors never caught on; but that in itself is a great accomplishment because "natural selection" applied to rotorcraft configurations won the day.

12. Maps of the Site:

Figure 7 shows the overall location, north of the St. Louis Lambert International Airport, where McDonnell helicopters were designed, built and tested. Much of the activities that took place on these buildings (Buildings 42 and 45 specifically) have been curtailed or moved to other locations with the passage of time.

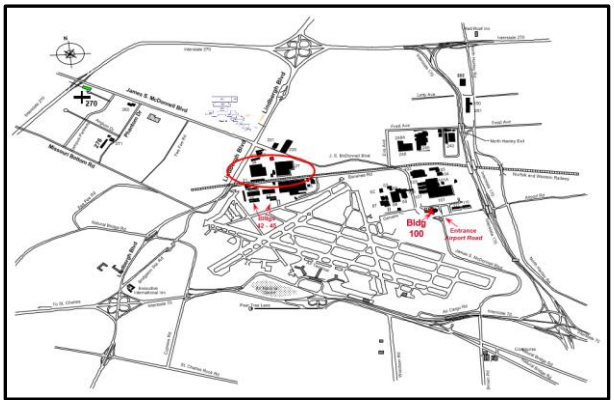

Figure 7. General location of the main buildings and facilities that formed McDonnell Aircraft Corp. (within the red ellipse)

No maps are available of the Smartt Field hot whirl rig location and layout. Further research is needed on this important area.

Figure 8 depicts the current location of Boeing Headquarters in St. Louis where the plaque could be placed with Boeing concurrence. The headquarters are with a mile radius of where former McDonnell Aircraft facilities such as Buildings 42 and 45 were located. It also houses the *Prologue Room*, dedicated in great part, to the history of the McDonnell Douglas Aircraft Company.

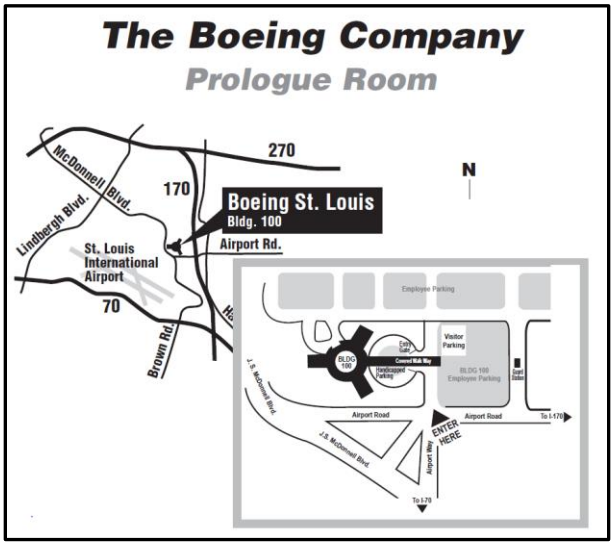

Figure 8. Potential location of the Vertical Flight Heritage Plaque (Prologue Room within Boeing Headquarters Building).

13. Drawings of the Site:

No drawings are available of the site, hot whirl tip-jet rig, etc. at this time due to the difficulty of finding long lost material, but this could be available and included on a future revision of this brief history.

14. Photos of Significance:

Much of the helicopter design work and wind tunnel testing was conducted at or near Buildings 42 and 45 (Figure 9), located adjacent to Banshee Road, in Hazelwood, MO. Models were briefly tested in Bonneville Salt Flats, Utah; and the rotor rigs used for tip-jet testing where installed in Smartt Field as mentioned above (Also, see Reference 1, p. 15 and Reference 8, pp. 58-59).

A priceless collection of photographs of the XV-1 during a demonstration to the media at the MAC flight line, and the Model 120 Fort Belvoir demonstrations to the U.S. Army, were captured by the late *Aviation Week* editor, correspondent and talented photographer Erwin J. Bulban. The photographic record of these beautiful aircraft could be obtained from aviation historian and photographer Jay Miller with the proper permissions. Figure 4 above is a fine example (even in low resolution) of such photographs.

Figure 9. The iconic Buildings 42 and 45, part of McDonnell Aircraft Corporation circa 1959 (Courtesy of Boeing).

15. Articles Concerning the Site:

An excellent article summarizing the history of McDonnell Aircraft Corp. and its involvement in helicopter design and manufacture was published by the American Institute of Aeronautics and Astronautics (AIAA) St. Louis Chapter, in their September 2006 newsletter *Gateway News*. In the article, photos and references are included which capture this very exciting period in the history of McDonnell Aircraft Corp., which later became McDonnell Douglas, and was recently made part of the Boeing conglomerate. The article's particulars are included in the Reference section (See Reference 9). Two very complete papers summarizing the helicopter developments at MAC are References 8 and 10.

16. References:

1. Allen, Francis J., *The McDonnell XV-1*, Journal of the American Aviation Historical Society, Spring 1993.

2. Allen, Francis J., *McDonnell's Aerial "Jeep"*, Journal of the American Aviation Historical Society, Spring 1994.

3. Doblhoff, Friedrich L., *Some Characteristics and Limitations of the Unloaded Rotor Compound Helicopter*, McDonnell Aircraft Corp., undated.

4. Francillon, Réne J., *McDonnell Douglas Aircraft Since 1920: Volume II*, Naval Institute Press, 1990.

5. Hohenemser, Kurt H., *Aerodynamic Aspects of the Unloaded Rotor Convertiplane Helicopter*, Paper presented at the 9th International Congress of Applied Mechanics, Brussels, Belgium, 5-13 Sep 1956.

6. Marks, Marvin D., *Flight Test Development of the XV-1 Covertiplane*, Paper presented and the AHS 3rd Annual Western Forum, Dallas, Texas, 8 Oct 1956.

7. Novak, Lloyd R., *The Evolution of the McDonnell Model 120 Crane Helicopter*, Paper presented at the 4th International Congress on Rotary Wings and Vertical Flight, Paris, France, 15-18 Jun 1959.

8. Roever, Frederick. H., *History of the Helicopter Engineering Division McDonnell Aircraft Corporation*, AHS Journal, Vol. 1, No. 1, Jan 1956, pp. 56-60.

9. Ross, Frederick W., *Mr MAC's Helicopters*, Article published on the AIAA (St. Louis Section) newsletter *Gateway News*, Sep 2006.

10. Shank, Troy C., *The McDonnell Aircraft Corporation Tip-Jet Convertiplane Program*, Paper presented at the AHS 62nd Annual Forum, Phoenix, AZ, 9-11 May 2006.

Summary and Milestones

The following table depict dates or milestones which are relevant to the rotorcraft designed and developed on the McDonnell Aircraft Corp. site. The table also include other relevant dates which pertain to the mergers and acquisitions (dates were obtained from Reference 4, a great resource for a complete history of the McDonnell Douglas Aircraft Company and its divisions):

McDonnell Aircraft Corp. Helicopter Division Milestones and Significant Events	Dates
McDonnell Aircraft created and incorporated	6 Jul 1939
Platt-LePage XR-1 contract awarded	Jul 1940
McDonnell Aircraft Corp. helicopter engineers join Platt-LePage's team	1943*
McDonnell Aircraft Corp. helicopter engineers open an office in Upper Darby, PA	Nov 1943
McDonnell Aircraft Corp. helicopter engineers are moved back to main St. Louis plant	1944*
Work on the McDonnell XHJD-1 *Whirlaway* begins	15 May 1944
McDonnell XHJD-1 contract awarded	23 Mar 1945
First flight of the McDonnell XHJD-1	27 Apr 1946
First flight of the McDonnell XH-20 *Little Henry*	29 Aug 1947
Letter of Intent signed for compound helicopters research (Phase I)	20 Jun 1951
Phase II research on compound helicopters awarded by the U.S. Air Force	Feb 1952
Hot whirl test stand / rig construction begins at Smartt Field	Mar 1952*
First flight of the McDonnell Model 79 *Big Henry*	26 Mar 1952
U.S. Navy contract awarded to develop the XHCH-1 (Model 86)	11 Apr 1952
First untethered "free" flight of the McDonnell XV-1 *Convertiplane*	14 Jul 1954
The XV-1 becomes the first rotorcraft to exceed 200 mph	10 Oct 1956
First flight of the McDonnell Model 120	13 Nov 1957
The hot whirl test stand / rig at Smartt Field begins operations in support of the XHCH-1	Dec 1957
The Model 120 is demonstrated to the U.S. Army in Fort Belvoir, Virginia	Nov 1958
XHCH-1 Project cancelled by the U.S. Navy	Jan 1959
XHCH-1 development work discontinued by direction of MAC management	Jun 1961
McDonnell Aircraft Corporation merges with Douglas Aircraft Company becoming McDonnell Douglas Aircraft Company (known by the acronym MDC)	28 Apr 1967
Mr. James S. McDonnell passes away	22 Aug 1980
MDC acquisition of Hughes Helicopters	6 Jan 1984
McDonnell Douglas Helicopter Company established	27 Aug 1985
MDC merger with Boeing	1 Aug 1997

* Dates provided are the best estimates based on References 8 and 9.